KFRI Handbook No. 22

An Annotated Bibliography on Teak (*Tectona grandis* Linn. f.)

N. Sarojam

Kerala Forest Research Institute
An Institution of Kerala State Council for Science, Technology and Environment
Peechi – 680 653, Thrissur, Kerala, India

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The Kerala Forest Research Institute (KFRI) is one of the six institutions under the Kerala State Council for Science, Technology and Environment (KCSTE) of the Government of Kerala, established in 1975. By conducting time-bound multi-disciplinary applied research in thrust areas of tropical forestry, KFRI has created a niche among the leading forest research organizations in tropics. The Institute undertakes multi-disciplinary research on all aspects of tropical forestry including wood science and technology, wildlife biology and socio-economics under the Research Divisions. KFRI has a Sub-Centre at Nilambur and a Field Station at Veluppadam for carrying out nursery and plantation trials, germplasm collection, etc. KFRI has the largest collection of bamboo and rattan species in India for research and conservation purpose. Also at Nilambur, there is a Teak Museum, the only one of its kind, devoted to a single tree species in the world: it is open to public, researchers, forest officials and all others interested in teak.

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भारत सरकार
पर्यावरण एवं वन मंत्रालय
DIRECTOR GENERAL OF FORESTS & SPL. SECY.
GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT & FORESTS

FOREWORD

Teak is the undisputed global leader of tropical timbers. It is used as the standard timber with which the qualities of other tropical hardwoods are compared in assessing their utilization potential. Teak, which is grown naturally in the Indian peninsula, Myanmar, Thailand, Laos and Indonesia, is now widely planted even beyond its natural range of occurrence. Teak is being planted now in Bangladesh, China and many countries of Africa, Central and South America and the Caribbean Islands. World's first teak plantation was raised at Nilambur in Kerala, India during 1840s, opening the way to ensure a steady supply of plantation grown teak timber in the face of dwindling supplies of teak from the natural habitat. Lately, teak has attracted the investors' attention on production of high quality timber from both public and private lands. The need for intensive management of teak plantations has been well understood as teak supports many wood-based industries and generates employment for thousands of people. There exists scope for selection of provenances and progeny from individual plus trees for fast growth without adversely affecting the strength of wood. As a naturally durable timber, teak found its place in the construction as well as furniture sectors. In view of the immense importance of teak and great value, much research has been done on this timber world over. Bibliographies of this kind form a readily available and valuable source of information to researchers and practicing foresters. It will help them to be up to date with the recent research results on all aspects of teak from around the world and also know the gaps in knowledge. This annotated bibliography is an attempt to cover up to date world literature on teak drawing references from different sources. I am sure this bibliography being brought out after a gap of 30 years, the last one being by Krishna Murthy (1974), will be very useful to researchers, foresters and industrialists. I wish to congratulate the Kerala Forest Research Institute for bringing out an excellent publication, which will fill a gap in information on teak for quite sometime.

New Delhi
12th October 2004.

(N.K. Joshi)

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PREFACE

Teak is one of the most important timber species of the world. Teak plantations are grown extensively not only in its native home range covering India, Myanmar, Thailand, Laos and Indonesia but also in many other countries in Asia, Africa, Central and South America and the Carribbean Islands. Intensive work has been carried out on different aspects of the species like genetic improvement, provenance trials, selection criteria for superior phenotypes, improved seed strategy, phenology, flowering and pollination processes, seed germination, vegetative propagation and tissue culture, plantation raising and management, properties, treatment and utilization of the timber. The research results are published in different forms like journal articles, reports, books, theses, conference proceedings, etc. and are widely scattered. An effort has been made to cover the details of all these publications in the form of a bibliography. A total of 4781 references have been compiled in this bibliography. The references included date back to year 1856 to the present. References are arranged under broad subject categories alphabetically by author's name. This bibliography will fill a long felt gap in access to information on teak and will be useful to researchers, forest officials and all those who are interested in teak wood.

Peechi
30 September 2004

J.K.Sharma
Director

ACKNOWLEDGEMENTS

I am grateful to Dr. J.K. Sharma, Director and Dr. R. Gnanaharan, Research Coordinator for their encouragement and support. Support of Mr. Sankara Pillai, Programme Coordinator, Library and Information Division for providing facilities for the work is gratefully acknowledged.

I wish to record my sincere thanks to Dr. P.Vijayakumaran Nair, Scientist, Forest Information Management Division for developing the software for generating the subject index. My thanks are also due to Mr. K.H. Hussain, Library and Information Division for the help in using the software CDS/ISIS for developing the database. Dr. M. Balagopalan, Dr. E.P. Indira, Shri K.C.Chacko, Mrs. P. Rugmini, Dr. K.V. Bhat, Dr. K.V. Sankaran and Dr. Sajeev, scientists of the Institute are gratefully acknowledged for their editorial comments. I am also thankful to Mrs. I.R. Jeena for her help in data entry work.

INTRODUCTION

The sterling qualities of teak wood, considered as the queen of timbers, are well known. Teak is extensively planted in the tropics and the demand for plantations continues to be on the increase. Research on various aspects of the species have been carried out for over 100 years in India, Myanmar, Thailand and Indonesia. Now the research is mainly focusing on producing quality wood in a short period. Intensive work has been carried out on different aspects of the species and the research results are published in different forms like journal articles, reports, books, theses, conference proceedings, etc. and are widely scattered. An effort has been made to cover the details of all these publications in the form of a bibliography, which is searchable by author and subject. The bibliography will guide a user as to what literature is existing on a particular subject for this species. A total of 4781 references have been compiled in this bibliography. The references date back to year 1856 to the present. This work will help research workers and all those working on teak to acquaint themselves with all the literature available and thus guide future research on teak. The bibliography was compiled under a project funded by the Kerala State Council for Science, Technology and Environment. Since this work was carried out in a short period of time, there is a possibility that some references may have been left out.

How to use the bibliography

This bibliography can be used in several ways. One can browse through the contents to locate the topic of interest and get an idea of the work carried out under the subject. The references are arranged alphabetically by author's name under broad subject categories. A short abstract is given for most of the references. Separate author and subject indexes have been provided. The numbers given against each author correspond to the serial number of the reference in the bibliography. The permuted subject index provided at the end of the document will help to locate the exact information provided in the document.

Sources of information

All the available bibliographies on teak (Krishna Murthy, 1974; Mathur, 1973, FAO, 1973) were referred for preparing this document. Forestry Abstracts, Forest Products Abstracts, Chemical Abstracts, Biological Abstracts, Current Contents and AGRIS database were also referred for the latest references. Some of the websites were also useful for getting recent references. All the available documents in KFRI Library were scanned through for the purpose of updating the bibliography.

CONTENTS

Foreword
Preface
Acknowledgements
Introduction
Bibliography
General 1
Country Reports 3
Environmental Factors 7
Site Factors 10
Undergrowth 13
Animals and Birds 17
Soil Properties 18
Litter Decomposition 46
Soil Microorganisms 55
Soil and Water Conservation 62
Plant Botany 65
Plant Chemistry 66
Plant Physiology 73
Plant Embryology 76
Plant Morphology, Anatomy and Histology 77
Dendroclimatology 81
Genetics and Breeding 83
Plant Pollination 91
Genetic Improvement 94
Ecology and Distribution 118
Vegetation Ecology 126
Silviculture 127
Regeneration and Formation of Stands 132
Seed Collection, Storage and Germination 146
Nursery Practices 166
Vegetative Propagation and Tissue Culture 173
Plantation Establishment 185
Plantation Techniques and Management 198
Field Trials 220
Fertilizer Trials 221

Agroforestry 227
Harvesting 239
Injuries and Protection 244
Drought, Pollution and Stress 245
Forest Fire 247
Damage by Plants, Weeds and Control 249
Damage by Animals 253
Fungi and Bacteria 254
Insect Pests 262
Biological Control 292
Chemical Control 300
Surveying and Mapping 303
Growth and Yield 306
Productivity 334
Management 352
Marketing 356
Wood Industry 361
Wood Properties 362
Wood structure and Properties 370
Physical and mechanical properties 377
Chemical Properties 391
Wood Working Properties 399
Thermal Properties 402
Natural Durability 404
Preservative Treatments 412
Wood Grading 415
Wood Utilisation 417
Wood Composites 421
Fodder, Medicinal, etc. 426
International Forest Policy 429
Author Index 431
Subject Index 461

BIBLIOGRAPHY

Go top
CONTENTS

The subject is covered under the following headings. It is possible to branch to particular topics in the hard copy document enclosed.

Top
Bibliography
- General
- Country Reports
- Environmental Factors
- Site Factors
- Undergrowth
- Animals and Birds
- Soil Properties
- Litter Decomposition
- Soil Microorganisms
- Soil and Water Conservation
- Plant Botany
- Plant Chemistry
- Plant Physiology
- Plant Embryology
- Plant Morphology, Anatomy and Histology
- Dendroclimatology
- Genetics and Breeding
- Plant Pollination
- Genetic Improvement
- Ecology and Distribution
- Vegetation Ecology
- Silviculture
  - Regeneration and Formation of Stands
  - Seed Collection, Storage and Germination
  - Nursery Practices
  - Vegetative Propagation and Tissue Culture
  - Plantation Establishment
  - Plantation Techniques and Management
  - Field Trials
  - Fertilizer Trials
- Agroforestry
- Harvesting
- Injuries and Protection
  - Drought, Pollution and Stress
  - Forest Fire
  - Damage by Plants, Weeds and Control
  - Damage by Animals
  - Fungi and Bacteria

- Insect Pests
  - Biological Control
  - Chemical Control
- Surveying and Mapping
- Growth and Yield
- Productivity
- Management
- Marketing
- Wood Industry
- Wood Properties
  - Wood structure and Properties
  - Physical and mechanical properties
  - Chemical Properties
  - Wood Working Properties
  - Thermal Properties
  - Natural Durability
  - Preservative Treatments
  - Wood Grading
- Wood Utilisation
  - Wood Composites
  - Fodder, Medicinal, etc.
- International Forest Policy

Author Index

Subject Index

Go top

General

0001 Chand Basha, S; Mohanan, C; Sankar, S (Eds). 1997. **Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991**. Kerala Forest Department, Trivandrum and Kerala Forest Research Institute, Peechi: 274p.

This book contains over 50 papers presented at the conference. A keynote address by Dr. Y.S Rao, outlines the importance of teak both within its natural distribution area (India, Myanmar, Thailand and Laos) and in locations where it has been established as an exotic plantation species (tropical West Africa, Bangladesh, Malaysia, Indonesia, Central America and the Caribbean).

0002 Forest Research Institute, Dehra Dun. 1959. **Proceedings of All India teak study tour and symposium, December 1957 - January 1958**. Forest Research Institute, Dehra Dun: 196p.

The papers are on different aspects of teak such as silviculture and management of teak forests of Madhya Pradesh, Bombay, Mysore, Madras, W. Bengal, Rajasthan, Burma and Andhra Pradesh, regeneration, thinning, soils, ecology, coppicing, plantations of Konni, Nilambur and Kurseong Forest division.

0003 FORSPA, Bangkok. 1993. **Teak in Asia**. Proceedings of the China/ESCAP/FAO Regional Seminar on Research and Development of Teak, Guangzhou, China, 19-27 March 1991. H. Wood, Ed. FORSPA Publication, Bangkok: 126p.

Fourteen papers covering various aspects of silviculture research on teak in various Asian countries such as Bangladesh, China, India, Indonesia, Laos, Myanmar, Philippines, Sri Lanka, Thailand, Vietnam and genetic improvement works, planting techniques, storage techniques and growth pattern are included.

0004 Hulster, I.A de. 1972**. A note on *Tectona grandis*. Linn.f. (Verbenaceae).** 21p.

The climate and type of occurrence, soils, botanical characteristics including wood properties, exploitation, fruiting and germination, natural regeneration, coppicing and taungya cultivation, mixtures in teak plantations, thinnings, yields, protection against pests, fungi, diseases and insects affecting teak are generally discussed.

0005 Karunakaran, C.K. 1995. **Thekk (teak). Rev. Ed**. (Malayalam). State Institute of Languages, Thiruvananthapuram: 198p.

A general account of the qualities of teak timber, genetic improvement programmes, silviculture, pests and diseases, etc. is given. A short history of teak plantation establishment in Kerala is also given.

0006 Kerala Forest Research Institute, Peechi. 1995. **Teak (*Tectona grandis*)**. KFRI Information Bulletin 13. Kerala Forest Research Institute, Peechi: 8p.

A general account of distribution, habit and habitat, cultivation and management, nursery practices, stump preparation and field planting, intercropping, weeding, thinning, pests and diseases, wood properties, utilisation and yield of teak is given.

0007 Kerala Forest Research Institute, Peechi. 1996. **Teak (*Tectona grandis*)**. (Malayalam). KFRI Information Bulletin 14. Kerala Forest Research Institute, Peechi: 8p.

Describes distribution, habit and habitat, cultivation and management, nursery practices, intercropping, weeding, pests and diseases, wood properties, utilization etc. in general.

0008 Krishna Murthy, A.V.R.G. 1974. **A bibliography on teak, *Tectona grandis* Linn.f.** Jugal Kishore & Co., Dehra Dun: 402p.

A survey of the world literature covering about 2961 references with abstracts to the more important ones. Abstracts are arranged alphabetically by author.

0009 Mathur, K.B.L. 1973. **Teak bibliography. Titles with abstracts of important ones, of world literature dealing with *Tectona grandis* Linn.f.** Delhi, Manager of Publications: 320p.

References are arranged chronologically, to literature published from 1829 to 1970. There are indexes to authors and subjects.

0010 Moldenke, H.N. 1954. **Additional notes on the genus Tectona I and II**. Phytologia 5(3/4): 112-120.

I. Literature citations, synonymy, nomenclature and general notes on the genus *Tectona* and the species *T. grandis*. II. Literature citations and synonymy relating to *T. grandis*, *T. grandis* f. *abludens*, *T. grandis* var. *glabrifolia*, *T. hamiltoniana* and *T. philippinensis*.

0011 Pandey, D; Brown, C. 2000. **Teak: A global overview**. Unasylva 51(201): 3-13.

An overview of ecology, management of natural forests, history, areas and planting rates, management, productivity and volume estimates of plantations, roundwood production and trade, policies and legislation affecting teak management, production and trade and environmental issues of teak is presented.

0012 Pankaj Khullar (Ed). 1995. **Focus on teak**. Indian Forester 121(6): 445-589.

Twenty-one papers are included in this special issue which covers various aspects of teak, silviculture, growth, management, economics, pests and diseases, and wood properties and uses.

0013 Rao, Y.S. 1991. **Key note address at the International Teak Symposium, Trivandrum, December 1991**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi: 1-6.

Aspects of geographical distribution, growing conditions, regeneration, breeding and teak improvement, processing and marketing of teak are covered.

0014 Tajuddin, E; Anoop, E.V; Jacob, S. 1996. **Teak**. Kerala Agricultural University, Trichur: 59p.

A short account of distribution, climate and ecology, phenology, silviculture, regeneration, insect pests and diseases, tree improvement, properties and utilisation, and yield and marketing of teak is given. A short account of teak in Kerala is also given.

0015 Tewari, D.N. 1992. **A monograph on teak (*Tectona grandis* Linn.f.)**. International Book Distributors, Dehra Dun: 479p.

This monograph presents comprehensive information on *Tectona grandis*, with particular reference to India. Chapters on distribution, morphology, anatomy, silviculture and management, ecology, biomass and nutrient dynamics, genetic improvement, growth and yield, marketing and trade, utilization; non-wood products; diseases, insect pests, pest management and general bibliography on teak are included. A subject index is also provided.

0016 United Nations Economic and Social Commission for Asia and the Pacific, Bangkok. 1991. **Report of the regional seminar on research and development of teak, Guangzhou and Hainan Province, China, 19-27 March 1991**. United Nations Economic and Social Commission for Asia and the Pacific, Agricultural Requisites Scheme for Asia and the Pacific, Bangkok: 22p.

Topics discussed at the seminar included the natural distribution, silviculture and management of teak forests, artificial regeneration of teak, processing, utilization and marketing of teak and a proposal on Asian regional cooperation involving the setting up of a network (TEAK-NET).

0017 White, K.J. 1991. **Teak: Some aspects of research and development**. RAPA Publication 17. FAO Regional Office for Asia and the Pacific, Bangkok: 70p.

Part one describes silvicultural characters of teak, distribution, timber and non-timber uses, teak as an exotic and environmental impact. Part two covers regeneration and silviculture, artificial regeneration, mensuration and teak research priorities.

0018 White, K.J. 1993. **A selection of annotated references of teak (*Tectona grandis* Linn. f.)**. Forestry Research Support Programme for Asia and the Pacific, Occasional Paper 19. FORSPA Secretariat, FAO Regional Office for Asia and the Pacific, Bangkok: 22p.

The abstracts are arranged under 13 subject headings: provenance trials, selection criteria for superior phenotypes, improved seed strategy, phenology, flowering and pollination processes, stimulating fruit production in seed orchards, germination of teak, vegetative reproduction - tissue culture, insect pests of teak and their control, diseases of teak, forest plantation management practices, utilisation of plantation grown timber and environmental impact of plantations.

0019 White, K.J. 1993. **Research results: A selection of annotated references of teak (*Tectona grandis* Linn.f.).** Occasional Paper 19. FAO, Bangkok: 22p.

Selected annotated references related to the major areas of priority identified research in plantation management such as provenance trials, selection criteria for superior phenotypes, improved seed supply strategy, phenology, flowering and pollination, etc. are included.

Go top

Country Reports

(See also 2133)

0020 Amatya, S.M. 2003. **Role of teak (*Tectona grandis*) in conserving biodiversity in Nepal**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

It is indicated that teak is not the preferred species for large scale plantations in Nepal. One of the reasons for this is the site requirements. Despite the promising growth of teak in some areas, it suppresses the undergrowth, not enriching species diversity. In Nepal, farmers and communities prefer multi-purpose tree species because of the long rotation period of teak.

0021 Andrade Countinho, Sylvio de. 2003. **Teak in Brazil: Plantations, know-how, expertise and market overview**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Describes the actual situation of teak plantations in Brazil, the technologies used in order to improve its productivity and local market development for first and second thinning teakwood. The advanced expertise in reforestations, the availability of fertile soils and manpower will make Brazil an important player in the teakwood market. A Brazilian and Dutch capital company founded in 1994, named Floresteca, is the largest teakwood investment in Brazil, managing over 14,000 hectares of teak plantations.

0022 Apichart Kaosa ard. 1992. **Teak in Thailand**. Teak in Asia. Proceedings of the ESCAP/ FAO Regional Seminar on Research and Development of Teak, Guangzhou, China, 19-27 March 1991. Technical Document GCP/RAS/134/ASB.FAO, Bangkok: 79-85. FORSPA Publication.

The cost of stump production by using the tissue culture method is 2-3 times higher than that of routine stumps. Tissue culture of teak was intensively studied in Thailand. The experience showed that teak can be successfully propagated using shoot/tip and/or nodal segment cultures.

0023 Ariyadasa, K.P. 2003. **Teak in Sri Lanka: Resource base, issues and challenges**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Teak is the most popular species used in reforestation programs in Sri Lanka. Development of commercial teak plantations has been the responsibility of Forest Department until recently. Current National Forest Policy of the country has provided the policy and legal frame work conducive to large scale private sector investment in forest plantation development. Apart from commercial teak plantations, home gardens play a major role in supplying teak to the domestic market.

0024 Banik, R.L. 1993. **Teak in Bangladesh**. Teak in Asia. Proceedings of the China / Escap / FAO Regional Seminar on Research and Development of Teak. H. Wood, Ed. FAO, Bangkok: 1-10.

0025 Behaghel, I. 1999. **The state of teak (*Tectona grandis*) plantations worldwide**. (French). Bois et Forests des Tropiques 262: 6-18.

An analysis is presented of teak plantations worldwide which include summary tables showing extent by country and by forest type. Extensive natural forests of Myanmar, India, Laos and Thailand are shown. Short reports are included of all countries where teak has been introduced as a plantation species. Teak plantations cover almost 3 million ha in the world, in more than 50 countries. Asia accounts for 90 percent of these plantations, including countries such as Sri Lanka, Bangladesh, Philippines and Vietnam.

0026 Cardoso, J.G Alfaro. 1952. **Report on Mozambique (P.E.A.)**. (French). Proceedings of the 1st Conference of Forestry Inter African Countries, Abidjan, 1951: 546-550.

Two thirds of the country is under forest. The situation of scarcity of timber has been created since the end of the war by the great expansion in timber operations. Trees planted which include teak.

0027 Chapuis, P. 1990. **Twenty years of forestry research in Cuba**. (French). Bois et Forests des Tropiques 223: 43-50.

A brief overview of the work of the Institute of Forestry Research in Cuba between 1969 and 1989, including species trials and tree breeding programmes for tropical broadleaved species including teak.

0028 Dilip Kumar, P.J. 2003. **Teak in Karnataka state, India**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Teak occurs mainly in mixture with other hardwood timbers in the mixed moist and dry deciduous forests, mostly in the Western Ghats. Teak plantation was a high priority in the forestry operations. Some 146367 hectares raised up to December 2001 in the state. The practice of clear felling have been discouraged and given up by the mid '80s.

0029 FAO. 1956. **Country reports on teak**. First Session, Teak Sub-Commission, Bangkok, 9-18 February 1956. FAO, Rome.

A review of progress reports on teak forestry at national level from Burma, Dahomey, Togo, France, India, Indonesia, Japan, Laos and Thailand dealt with silviculture, ecology, seed problems, forest protection, forest management and forest utilization of teak.

0030 Heringa, P.K. 1946. **Notes on forests and forestry in Java from December 1941 to April 1946**. (Dutch). Tectona 36(1): 8-18.

Teak fellings in Java in 1942 and 1943 were 50 and 100 per cent. higher than the normal permissible cut. In 1944 almost all teak over 80 years old was girdled, as well as that 40-80 years old in some forest districts of central Java. Much damage was done in the woods through theft, timber sheds and houses were also broken down and robbed. Almost all Dutch forest officers were interned and replaced by Indonesians, and revision of working plans stopped.

0031 Howard, S.H. 1946. **The forest situation and its problems in India**. For. Quebec. 11: 61-67.

The forest domain of the Government of British India is about 100,000 sq. miles out of a total area of 800,000 sq. miles, or more precisely 13 per cent. There are also nearly 50,000 sq. miles of private forest. The essential points of the Government's forest policy are summed up. It is believed that it will be possible to meet increasing urban consumption by an increase in production. The best stocked forests will not be exploited for another 20 years. A great part of these evils could be avoided by the restoration of the ancient forests. Plans for restoration are suggested.

0032 Htwe, U.M.M. 2000. **Teak plantations in Myanmar**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 83-98. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

The Forest Department formulated a special 40-year Teak Plantation Program based on previous experiences and according to international guidelines and conceptual frameworks. Tree improvement programmes of Myanmar Forest Department are discussed. Planting and post planting practices, site management, silvicultural treatments and plant protection measures for the country are also discussed. Certain recommendations are made for successful plantation management in the country.

0033 Hussain, S. 1959. **Teak in Mysore**. Proceedings of All India Teak Study Tour and Symposium, December 57-January 58, Forest Research Institute, Dehra Dun, 1959: 76-79; 159-163.

Describes teak in Mysore state with its occurrence, geology, soils, climate, system of management, principal silvicultural characteristics, method of exploitation, natural regeneration, artificial regeneration, plantation techniques, cultural operations, control burning etc. Teak cultivation methods, agrisilviculture, rab-planting etc., and research on thinnings and planting under-taken in the state are also discussed.

0034 Kala, J.C; Kumaravelu, G; Krishnakumar, N. 2003. **Status report of teak in Tamil Nadu**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December

2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Discussed the various studies going on in the state which include teak improvement works, pre treatment methods of seeds, inducing flowering in teak clonal seed orchard, drip irrigation, establishment of clonal teak plot.

0035 Katwal, R.P.S. 2003. **Teak in India: Status, prospects and perspectives**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Teak is a celebrated timber of tropics and India is one of the major teak growing and utilizing countries. Domestication through plantations for one and a half centuries has made teak the most widely planted and researched tropical hardwoods. Significant development has taken place in standardizing plantation techniques, perfecting harvesting and post-harvest utilization methods and tree improvement. Teak resources of the world need immediate attention for their sustainable management.

0036 Kijker, S. 2003. **Teak in Thailand**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Natural teak forests in Thailand decreased from 2,324,300 ha in 1954 to about 1,50,000 ha in 2000, mostly due to the demand for agricultural land and constructional wood by the increasing human population. Up to 2000, both private and public sectors in Thailand could establish only 8,36,000 ha of teak plantations, as reported by FAO. Thailand has to import natural teak wood from overseas, especially from Myanmar, Lao P.D.R. and Indonesia, on an average of about 2 billion Baht annually. Information on teak improvement, research and development programmes in the country is discussed and pointed out the constraints in teak plantation establishment.

0037 Krishnapillay, B; Razak, M.A.A; Ong, T.H. 2003. **Growing teak in Malaysia**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

This paper attempts to look at the state of teak plantations in Malaysia and the research and other efforts that has been carried out to date to support establishment of teak plantations in the country.

0038 Kumaravelu, G. 1993. **Teak in India**. Teak in Asia. Proceedings of the China/Escap/FAO Regional Seminar on Research and Development of Teak: 1-10. FAO, Bangkok

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0039 Lamb, A.F.A. 1954. **Teak**. General Paper 4th World Forestry Congress: 18p. Forest Research Institute, Dehra Dun.

The teak plantations of Trinidad are described, along with site factors, silviculture, injuries and protection volume and yield data, and the need for future reserch on teak is stressed.

0040 Ma, H.M; Liang, K.N; Zhou, Z.Z. 2003. **Research and development of teak in China**. Forest Research 16(6): 768-773.

An overview of recent teak research on introduction and domestication, culture regionalization, seed treatment, production and storage of seedlings and silviculture in China is presented. The developmental prospects and research direction of teak in China are also presented.

0041 Morehead, F.T. 1944 . **The forests of Burma**. Burma Pamphlets 5: 67p. Longmans, London.

A condensed account of the essential facts about the forests of Burma, their organization and exploitation. It includes topography and climate, forest trees classified according to Troup's silviculture of Indian trees, forest fauna, and particularly the life history of the elephant, a history of the development of forestry, administration, policy, legislation, organization, research, etc., exploitation by Government agency and by lessees, methods of extraction, uses and markets and minor forest products.

0042 Nagesh Prabhu, H. 2003. **Teak in Kerala - past, present and future**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Discusses the present and future management and marketing aspects of teak. Teak was first raised on plantation scale in Kerala during 1842. After that Kerala Forest Department has raised large extent of teak plantations. As on today state forest department manages 74,872 ha. of teak plantations and on an average 1000 ha. teak plantation is being felled and regenerated each year. After the first plantation raised in 1842 by direct sowing/planting natural seedlings and stump planting introduced by T.F. Bourdillon during 1891, to improve the productivity of 2nd and 3rd rotation teak soils, using quality nursery stock, KFD has introduced root-trainer technology. Now KFD is attempting to raise clonal teak plantations utilizing 30 clones developed by KFRI.

0043 Nghia, C.Q. 2000. **Teak (*Tectona grandis*) plantations in Vietnam**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 99-108. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

There is no natural teak stands in Vietnam. The Ministry of Forests intends to plant teak on 10,000 ha each year to reach a total area of about 0.5 million by 2030. Teak plantations in the country are managed by the state through the State Forest Enterprises, forestry companies and the Forest Seed Production Centre. Tree improvement programmes, plantation establishment, site preparation, silvicultural practices and the financial analysis of plantation management are discussed in this paper.

0044 Oteng-Amoako, A.A; Sarfo, D. 2003. **Development of teak plantations in Ghana - propagation, processing, utilization and marketing**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

The development of teak plantation in Ghana is traced from 1875 when a German missionary first introduced it to the present Volta Region of Ghana. The success of teak plantations in Ghana is dependant upon many factors including its ease of cultivation, fast growth, resistant to fire, tolerance to range of soils and rainfall and superior wood and working qualities. The new collaborative research programme with four other partner countries funded by the European Community, will improve the quality and productivity of future teak plantations in Ghana and West Africa sub region.

0045 Ramnarine, S; Jhilmit, S. 2003. **Teak in Trinidad and Tobago**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Teak was introduced into Trinidad in 1913 from Myanmar. Plantations were established give a total teak estate of some 9000 hectares ranging in age up to 90 yrs. old. Various methods of establishment have been tried in the early stages of introduction but by 1918. Challenges to management are high rates of soil loss, uncontrolled fires, theft and management of a second rotation crop. The forestry division has conducted various research experiments in teak over the years in nursery, thinning and spacing, tree improvement, growth studies and methods to reduce erosion and increase understorey vegetation.

0046 Rao, P.S. 2003. **Status of teak in Andhra Pradesh**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

The total planted area up to 2000-2001 is reported as 1,11,931 ha. in the state. Recently the natural teak bearing forests which became degraded due to heavy biotic interference are rejuvenated with the involvement of local people constituted into Vana Samithies under the Community Forest Management. Management of degraded teak forests under the World Bank funded Andhra Pradesh forestry project and Andhra Pradesh community forest management project are undertaken by the state. Teak improvement programmes in the state which include selection trials of plus trees, progeny trials, germplasm banks, development and standardisation of pre-treatment of seed and vegetative propagation, bud grafting, production and storage methods of scion material, trials for rooting of leafy cuttings are under way.

0047 Samapudhi, K. 1957. **Some notes on teak in S.E. Asia**. FAO Teak Sub-Commission, Bandung FAO/TSC-57/19: 6p.

Discussed distribution of teak in Asia and the Far East, methods of teak exploitation, physical and mechanical properties of teak from various teak producing countries like weight, seasoning, shrinkage, calorific value, influence of rate of growth on the technical properties and marketing and grading of teak logs, squares and conversions.

0048 Samapudhi, K. 1967. **Country report on teak forestry, Thailand**. FAO Asia-Pacific and African Forestry Commissions, Rome FAO:T-67/8: 7p. FAO, Rome.

Covers the following topics: teak bearing area, management, artificial regeneration, protection, research on teak soils, site quality, increment and volume tables, studies on seed selection, pretreatment and sowing, thinning, fire protection, control of teak bee-hole borer, mechanical properties and genetic research.

0049 Seth, S.K; Yadav, J.S.P. 1957. **Country report from India on silviculture and management of teak**. FAO Teak Sub-Commission, Bandung FAO/TSC 57/7: 21p.

A review of structure, nutrients and water relations, geology, pH and soil deterioration and soil conservation in teak plantations of India, Burma, Indonesia and Pakistan.

0050 Siswamartana, S. 2003. **The ups and downs of teak forest management in Indonesia**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

In Indonesia, teak was introduced during the fourteenth century. The Dutch colonial rule extensively extracted the timber, leading to degradation of teak forests in the country. There are state teak forests and community teak forests in Java. The state teak forests, extending to about 600,000 ha are managed by the government enterprise called Perum Perhutani and the teak areas outside Java are looked after by the local government. Clonal seed orchards are established. Intensive silvicultural practices, including fertilization are adopted to increase the productivity. Community based forest management programmes are implemented.

0051 Zakaria, I; Lokmal, N. 1995. **Teak in Malaysia**. 2nd Regional Seminar on Teak, Yangon, Myanmar.

Go top

Environmental Factors

(See also 0272)

0052 Agni, T; Pandit, A; Pant, K; Tewari, A. 2000. **Analysis of tree vegetation in the Tarai-Bhabhar tract of Kumaun Central Himalaya**. Indian Journal of Forestry 23(3): 252-261.

The present study was undertaken to assess the regeneration pattern, tree diversity and qualitative characters of forests in the Tarai-Bhabhar belt of Kumaun Central Himalaya in Uttar Pradesh. The highest abundance was recorded for *Tectona grandis*.

0053 Akinsanmi, F.A. 1985. **Effects of rainfall and some edaphic factors on teak growth in south-western Nigeria**. Journal of Tropical Forest Resources 1(1): 44-52.

Major site factors affecting the growth of teak in several areas of South West Nigeria were studied. Multiple regression analysis of the growth data and soil analysis showed that teak volume growth was significantly correlated with rainfall, texture, organic matter content and soil pH. The site conditions necessary for good growth of teak are discussed.

0054 Banerjee, K.L.B; Lal, P. 1985. **Vegetation of the little known district Seoni - in Madhya Pradesh**. Indian Journal of Forestry 8(4): 292-297.

A description of dry scrub jungle and mixed dry deciduous forest, which is further subdivided using the abundance of teak and local variations in altitude and climate.

0055 Bhatia, K.K. 1955. **Factors in the distribution of teak in Madhya Pradesh**. Journal of Indian Botanical Society 34(4): 459-490.

Climate, surface geology and vegetation in a number of teak stands are described. The soils were studied for pH, moisture content, exchangeable Ca, Mg, K, total available phosphates, N, organic matter and C/N. A positive correlation was established between the growth and distribution of teak and soil pH, exchangeable Ca, Mg and phosphates.

0056 Bhatia, K.K. 1956. Contribution to the ecology of teak (*Tectona grandis* Linn.f.) in

Madhya Pradesh. Science and Culture 21(12): 721-726.

Presents some further data from a study made in 1952-54 and discusses the discontinuous distribution of teak in Madhya Pradesh, pH of the soils and the Ca requirements of teak and its significance.

0057 Bown, D.N; Bang, Y.H; Knudsen, A.B; Arata, A.A; Fabiyi, A. 1980. **Forest types and arbovirus vectors in the Mamu River Forest Reserve of southeastern Nigeria**. Mosquito News 20(1): 91-102.

In the forest reserves of south-eastern Nigeria, the indigenous forests is cleared and replaced by teak and Gmelina plantations. Aedes africanus was found abundantly at ground level throughout the reserve.

0058 Buvaneswaran, C; George, M; Mohan, S. 2003. **Distribution of rainfall under teak plantation**. Indian Forester 129(5): 571-577.

It is found that the seasonal variation of rainfall influence the stemflow and throughfall. It is also found that interception depends on parameters like crown form, density of the species, external structural features like bark characteristics and branching nature as well as rainfall pattern and other meteorological factors which influence the evaporation.

0059 Camacho, M. P. 1985. **Environmental factors and growth of 5 forest tree species in Costa Rica**. (Spanish). Technologia en Marcha 8(1): 27-33.

Multiple regression models were developed using the m.a.i. in volume as the dependent variable and 27 environmental factors. Models of best fit are presented for each species including teak.

0060 Chaves Salas, E; Chinchilla Mora, O. 1989. **Limiting factors in the growth of teak (*Tectona grandis* Linn.f.) in the area of Puntarenas, Costa Rica.** Guia Agropecuaria, Costa Rica 7(14): p64.

0061 Chunkao, K; Tangtham, N; Surachet Ungkulpadikul. 1971. **Measurements of rainfall in early wet season under hill- and dry-evergreen, natural teak, and dry-dipterocarp forests of Thailand**. Kog Ma Watershed Research Bulletin, Faculty of Forestry, Kasetsart University, Thailand 10: 31p.

Throughfall comprised about 37 percent, stemflow comprised 0.02 percent of the precipitation and interception was 63 percent for natural teak. The differences were related to the texture of the bark and leaves of the trees, interception being higher for species with rough bark and hairy leaves.

0062 Classen, J.C van R. 1910. **Need of light or tolerance of shade and related matters**. (Indonesian; English). Tectona 3: 375-381.

0063 Coster, C. 1921. **The physiological aspect of light in forestry**. (Indonesian; English). Tectona 14: 1033-1045.

0064 Dabral, B.G; Bali, H.K; Bhalla, H.K.L. 1964. **Dew studies under forest plantations at New Forest, Dehra Dun**. Indian Forester 90(3): 169-170.

Studies made over two cold seasons in fully closed stands of *Pinus roxburghii*, *Tectona grandis* and *Dendrocalamus strictus* showed that dew deposition was much retarded under cover, especially immediately below the crowns. No frost was recorded inside these plantations.

0065 Dabral, B.G; Prem Nath; Ramswarup. 1963. **Some preliminary investigations on the rainfall interception by leaf litter**. Indian Forester 89(2): 112-116.

A study was made of interception of rainfall by litter of *Shorea robusta*, *Tectona grandis*, *Pinus roxburghii* and *Dendrocalamus strictus*. Interception as percent of gross rainfall averaged for teak is 8.9. Interception increased as amount and intensity of rainfall decreased.

0066 Dabral, B.G; Prem Nath. 1972. **The microclimate of teak plantation**. Proceedings of Symposium on Man Made Forests in India, 8-10 June 1972. Society of Indian Foresters, Dehra Dun.

The paper presents the results of microclimatic studies made under a teak plantation and in the open at New Forest. The presence of forest vegetation, modified air temperatures both by its sheltering and blanketing effects, the effects being more pronounced during the winter season. Under the plantation, inversion took place in day time which generally occurred at night in the open.

0067 Eze, E.B. 1999. **Relationship between rainfall interception and rainsplash erosion under teak plantation in south western Nigeria**. Global Journal of Pure and Applied Sciences 5(4): 589-593.

Gross rainfall, throughfall and stemflow were measured on a storm basis. Interception loss and splash erosion by throughfall were calculated. The results show that teak plants intercepted 16 percent of the gross rainfall while throughfall accounted for 81 percent and the balance of 3 percent was stemflow. An equation relating throughfall and rainsplash erosion under teak was developed.

0068 Ferlin, G. 1969. **Forests and forestry problems in Ceylon**. (French). Bois et Forests des Tropiques 127/128: 3-28.

An account is given of the climatic zones and the present distribution of forests, geology and soils, large-scale afforestation programme in progress mainly with *Tectona grandis* in the dry zone, *Swietenia macrophylla* in the wet zone, and Eucalypts and Pines in the highlands and of the timber industry.

0069 Gogate, M.G; Kumar, A. 1993. **An ecological audit of teak plantations in West Chandrapur Project Division**. Indian Forester 119(4): 265-294.

Data on floristic composition and stand structure are presented and compared for four teak plantations, four areas of natural forest either adjacent to teak plantations, or with a higher percentage of teak. It is found that clear felling followed by teak planting will not affect plant diversity. This finding is attributed to safety measures adopted at clear felling which involved retention of small patches of original forest in the form of section and compartment lines, roadsides, retention of fruit trees etc.

0070 Griffith, A.L. 1945. **Snowfall in Dehra Dun**. Indian Forester 71: 117-118.

Many of the exotic tree species under cultivation at Dehra Dun suffered severely of the snowfall and frost of 1945. Main stems were broken in a very large percentage of teak. The relative amount of damage suffered by the various species is shown in tabular form.

0071 Gupta, A.C; Gurumurti, K; Raturi, D.P. 1983. **Ratanmal Forest and some of its plant constituents**. Van Vigyan 21(1/2): 26-29.

The Ratanmal Forest is a 5565-ha reserved forest in the Panchmahals District of Gujarat. It has good quality moist teak and southern moist mixed deciduous forest types.

0072 Hadipoernomo. 1979. **Magersaren in teak forest**. (English; Indonesian). Duta Rimba 5(29): 10-15.

0073 Kulkarni, D.H. 1956. **Distribution of teak (*Tectona grandis*) on the northern slopes of the Satpuras, with special relation to geology**. Proceedings of the 8th silviculture Conference, Dehra Dun, 1951, Part 2: 254-266.

Extensive observations failed to establish any significant correlation between the distribution of teak and altitude, topography, rainfall, temperature or biotic factors. A correlation was found with geographical formation, the proportion of teak varying from 80 percent on rocks of the Deccan Trap Series to none on sandstones.

0074 Luangjame, J; Boontawee, B; Kliangpibool, N. 2001. **Determination of deposition and leaves in teak plantations in Thailand**. Water, Air and Soil Pollution 130(1-4): 935-940.

0075 Mwalyosi, R; Hughes, R. 1998. **The performance of EIA in Tanzania: An assessment**. Environmental Planning Group, International Institute for Environment and Development, Environmental Planning Issues 14: 95p. London, UK.

An examination is made to determine the influence of environmental impact assessment on decision-making at the national level within Tanzania. Seven case studies are presented which include teak plantation establishment.

0076 Nguyen Khac Hieu; Booth, T.H. 2003. **Application of the COMAP model for developing and evaluating forestry greenhouse gas mitigation options in Vietnam**. Carbon accounting in forests. Proceedings of an International Frontiers of Science and Technology Workshop, CSIRO Forestry and Forest Products, Canberra, Australia, 24 February, 2003: 56-64. Australian Academy of Technological Sciences and Engineering, Parkville, Australia.

Some of the main features of Vietnam's forests including the areas and annual growth rates of major forest types are described. The COMAP model is used to assess greenhouse gas mitigation options including three forestry options which include long-term rotation reforestation using species such as teak. It is concluded that the forestry sector has great potential to mitigate greenhouse gas emissions. There is a need to initiate significant pilot scale forestry mitigation options to demonstrate their feasibility, as well as to develop appropriate methods for assessing greenhouse gas flows and their verifiability.

0077 Plodpleaw, A. 1965. **Comparison of temperature in natural forest, teak plantation and open areas**. (Thai). Student Thesis. Kasetsart University, Bangkok.

No differences in temperature were found.

0078 Prasad, R. 1980. **Ecological status of *Diospyros melanoxylon* in dry deciduous teak forests of Sagar (Madhya Pradesh)**. Indian Forester 106(1): 41-52.

The forests of Sagar are very heterogenous in their composition, quality, density and extent. The microclimate differences produced due to variation in slope, aspect, relief, proximity to water courses, soil and geological formation cause a very perceptible variation in the vegetation. Besides the climatic factors, the edaphic and biotic factors also affect the distribution composition and quality of the crop. Diospyros melanozylon is found as main associate of forest stands.

0079 Qureshi, I.M. 1963. **The concept of tolerance in forest crops**. Silver Jubilee Souvenir 1938-1963. Indian Forest College, Dehra Dun: 90-100.

Attempts to determine whether the indices of tolerance prepared by Gevorkiantz on the basis of the relationship of mean height and mean diameter are applicable to those Indian species for which yield tables are available including teak.

0080 Salazar, F.R; Albertin, W. 1974. **Edaphic and climatic requirements for *Tectona grandis* Linn.f.** (Spanish). Turrialba 24(1): 66-71.

It is shown that *Tectona grandis* requires deep, well drained soil at a low elevation, and a frost-free climate with 3-5 months of drought.

0081 Siringoringo, H.H; Gintings, A.N. 1997. **The role of *Tectona grandis* forest plantations in absorbing carbon dioxide**. Buletin Penelitian Hutan 608: 1-18.

The role of teak in the CO_2 sequestration was investigated in plantations in Bojonegoro Forest District, East Java, where an analysis was undertaken of microclimatic conditions of light intensity, relative humidity, air pressure and temperature and ppm CO_2 in seven stand age classes. Absorption of CO_2 by the plantations varied by age class, with absorption ability highest in old age classes.

0082 Tiwari, S.D.N. 1954. **Teak the intruder *vis-a-vis* occurrence of teak in sal forests of Bastar**. Indian Forester 80(6): 332-337.

It is considered that teak was introduced from the south at an early date. It appears to be gradually supplanting sal in the forests of this area.

0083 Verma, R.K; Gupta, S.R; Anand, K. 2000. **Floristic composition and life form of a mixed dry deciduous forest of Central India**. Flora and Fauna Jhansi 6(2): 79-81.

A study was conducted to determine the botanical composition and life form of a natural mixed dry deciduous forest in the Bundelkhand region in Uttar Pradesh. Results showed that 23 species comprise the study area out of which the two most common and dominating species were *Anogeissus pendula* and *Tectona grandis*.

Go top

Site Factors

(See also 0172, 0342)

0084 Akindele, S.O. 1991. **Development of a site index equation for teak plantations in southwestern Nigeria**. Journal of Tropical Forest Science 4(2): 162-169.

A site index equation is developed for estimating the site quality of existing teak plantations in SW Nigeria. The procedure for using the equation is illustrated.

0085 Boonkird, S; Dawson, M.D; Stone, E.L. 1960. **A preliminary study of teak soils and sites in Lampang province, Thailand, June 1960**. Journal of the National Research Council of Thailand 1(1): 27-75.

A study is made of natural teak forests in northern Thailand mainly soils and vegetation and measurements of mature teak trees. Height of mature teak, which was found to be related closely to volume, fairly closely to girth, but not to current diameter growth and was considered a good index of site quality. A positive correlation with organic-matter content, internal drainage, rooting depth, and most markedly with soil moisture storage capacity but none with pH, P content, or ground vegetation.

0086 Chand Basha, S; Sankar, S. 1997. **Future of teak in Kerala**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 208-211. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Kerala State has a long history of teak cultivation and plantations of the third rotation can be located at Nilambur Forest Division. This paper attempts to review the status of teak plantations in Kerala *vis-a-vis* site quality, soil conditions, rotation age, etc. A critical analysis of teak culture with specific case studies on growth of teak and soil and site conditions is presented. While discussing certain options for further course of action, an attempt is made to predict the future of teak in Kerala.

0087 Chauhan, V.S. 1973. **Relationship of some components of physical environment to the site quality of teak in Madhya Pradesh**. Silvicultural Conference, 6-10 December, 1977. Forest Research Institute, Dehra Dun.

An evaluation of site quality of teak in relation to elements of climate and soil is made. A general equation has been evolved for forecasting the site quality through the basic data of physical environment, comprising of soil and climate of eleven forest divisions, ranging from dry to moist teak zones.

0088 Drechsel, P; Zech, W. 1994. **DRIS evaluation of teak (*Tectona grandis* Linn.f.) mineral nutrition and effects of nutrition and site quality on teak growth in West Africa.** Forest Ecology and Management 70(1/3): 121-133.

An investigation was made to study site variables controlling teak yield and to establish guidelines for the selection of high productivity sites in Benin, Cote d'Ivoire, Liberia, Nigeria and Togo. Depending on stand age, soil and region, between 70 and 90 percent of the variation in tree growth could be explained by the supply of nitrogen, root available, soil depth and precipitation.

0089 Forest Department, Andhra Pradesh. 1966. **Note on selection of area for planting with teak**. Forest Department, Andhra Pradesh, C.C.F's 73473/65/H4 Dt. 29-6-1966.

A departmental note in the form of instructions for selection of area for teak planting and proper survey of forest soils, to determine their suitability.

0090 Haeruman, H. 1970. **Linear combination of stand variables as a means for site classification of teak (*Tectona grandis* Linn.f.) plantations in Java.** De University, USA: 66p.

0091 Haeruman, H. 1971. **Problems in assessment of site quality**. Rimba Indonesia 16(1/2): 1-10.

A review, concluding that in managed plantations there are advantages in the simultaneous use of height, d.b.h. and age to assess site quality.

0092 Herrera, B; Alvarado, A. 1998. **Site quality and environmental factors in Central American forests**. Agronomia Costarricense 22(1): 99-117.

Published information related to the estimation of the productive capacity of sites were compiled based on environmental factors in forests of known age in Central America. The methods used to estimate age, the size and the number of sample plots, the site quality indicators, the criteria used in the selection of each study site and the soil sample depth were compared. The climatic, topographic and soil factors that affect the productive capacity of the species considered were also analysed.

0093 Kadambi, K. 1945. **Teak plantations in Mysore and their site quality**. Indian Forester 71: 58-62.

Most of the early plantations of teak in Mysore were formed on sites adjoining rivers, owing to the once prevalent idea that the proximity of running water was necessary for the successful regeneration of this species. Data are given showing the rate of growth of teak in Mysore as compared with that of other sites in different parts of India.

0094 Keogh, R.M. 1982. **Teak (*Tectona grandis* Linn.f.) provisional site classification chart for the Caribbean, Central America, Venezuela and Colombia.** Forest Ecology and Management 4(2): 143-153.

Based on top height, dominant height and dominant/codominant height data from thirteen countries is given.

0095 Kolmert, A. 2001. **Teak in Northern Laos**. Minor Field Studies, International Office, Swedish University of Agricultural Sciences 175: 40p. Swedish University of Agricultural Sciences, International Office, Uppsala, Sweden.

A study was made to evaluate land use for teak plantations and its implications. Teak plantations on flat, gentle and steep slopes were studied in order to describe teak growth rates, erosion, undergrowth, soil properties for the different slope categories, ownership structure and management. It is suggested that intercropping will be an effective measure to mitigate erosion.

0096 Kulkarni, D.H. 1956. **Geography of sal and teak with special reference to Madhya Pradesh**. Proceedings of the 9th Silvicultural Conference, Dehra Dun, 1956, Part 2: 108-112.

The natural distribution of these two species and specially their economic relationship in Madhya Pradesh are discussed in the light of their characteristics and evolutionary history.

0097 Lauridsen, E.B; Apichart Kaosa ard. 1973. **Site effects unstored more than stored stumps of teak**. TIC Experiment 77: 13p. Teak Improvement Centre, Ngao.

Gives the results of experiments done on treatments - control and underground storage, with different storage media-sawdust; rice shells and plastic foil and with different lifting dates for plants to stored and unstored plants. Storing medium has no effect on survival and development. Ground storage is associated with higher levels of survival.

0098 Lu-Junpei. 1994. **Site classification and evaluation of teak forests in Hainan, China**. (Chinese). Forest Research 7(6): 677-684.

The site classification and evaluation of teak forests in Hainan Island were studied. The site index is used as a criterion variable and the six ecological factors are used as explanatory variable in which the soil fertility is one of the ecological factors.

0099 Maimongkol, W. 1965. **Determination of the value of constants of teak from form factors and form quotients in Huay-Tark Forest, Ngao, Lampang**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Use of Girard form class and 1/10 form class to find out taper form of site class 1-4 is discussed. Use of Kunze form factor for different site classes and its relative significance is also discussed.

0100 Marcelino Montero, M; Ugalde Arias, L.A; Kanninen, M. 2001. **The relationship between site index and site factors known to influence the growth of *Tectona grandis* Linn.f. and *Bombacopsis quinata* (Jacq.) Dugand, in Costa Rica**. (Spanish). Revista Forestal Centroamericana 35: 13-18.

Site indices for *Tectona grandis* and *Bombacopsis quinata* were correlated to site and soil variables obtained from different regions in Costa Rica. Mean annual precipitation presented a positive correlation with site index for *T. grandis*. Site index for *T. grandis* also presented a positive correlation with topographic position, indicating that the species grows well in flat lands and on medium slopes.

0101 Morellet, J. 1968. **Forestry problems in Cuba**. (French). Bois et Forests des Tropiques 122: 3-24; 123/124: 3-17.

An account is given of climate, topography, geology and soils, forest history, forest types, afforestation by planting softwood and hardwoods planted include *Tectona grandis*, silvicultural research, forest production and problems of land use and forest policy.

0102 Neumann, A; Neumann, A.J. 1988. **Provisional site index curves for five Solomon Islands plantation species**. Forestry Division, Solomon Islands, Forest Research Note 42-10-88: 9p.

Site index equations and curves are presented for different species which include *Tectona grandis*, based on data from permanent sample plots, permanent growth plots and experimental trials at three sites. Descriptions of soil types, land form and fertility are given for each site.

0103 Raghavan, M.S. 1948. **Further note on constants connecting top height and age for different site qualities in teak plantations**. Indian Forester 74(5): 209-210.

The paper puts forth a formula method of determining the equality of a teak plantation of known age and top height points out the need of exploratory work on actual observed data before establishing the relationship.

0104 Rao, B.K.S; Pande, S.K. 1982. **Effect of forest tree and litter covers on climate near the ground including surface soil temperature and soil moisture in three forest plantations of chir (*Pinus roxburghii*), sal (*Shorea robusta*) and teak (*Tectona grandis*) at New Forest, Dehra Dun**. Indian Forest Records, Forest Influences 1(1): 74p.

0105 Sahunalu, P; Phromsilp, V; Suraphapmaitri, S. 1992. **Site index and yield of teak plantation in Lampang**. Proceedings of the Seminar on 50 Anniversary of Hyay-Tak Teak plantation, Bangkok, 5-8 August 1992.

Study of site index and yield of teak plantation was carried out in nine plantations of Lampang province. Diameter at breast height and total height of teak in plots were measured. The relationship between age and average height of the dominant and co-dominant trees in each plot was found out and a curve was drawn to form the site index.

0106 Salifu, K.F. 2001. **Site variables controlling teak (*Tectona grandis*) growth in the High Forest Zone of Ghana**. Journal of Tropical Forest Science 13(1): 99-108.

Site variables controlling teak growth are investigated to recommend guidelines for the selection of suitable and highly productive sites for industrial scale teak plantation establishment. Regression techniques were used to relate teak dominant height growth with soil textural properties under teak plantations in the High Forest Zone of Ghana.

0107 Tanaka, N; Hamazaki, T; Vacharangkura, T. 1998. **Distribution, growth and site requirements of teak**. JARQ, Japan Agricultural Research Quarterly 32(1): 65-77.

The successful teak plantations are found in discontinuous areas with fertile soils, which are intrazonal and azonal soils derived from limestones, base-rich igneous rocks and alluvial materials. The discontinuous distribution of natural forests and plantations of teak is attributed to the discontinuous occurrence of suitable intrazonal and azonal soils. The optimum soil conditions for teak growth include good drainage, deep subsoil, slightly acid to alkaline pH, and abundance of bases.

0108 Thammanon, P. 1970. **Site quality of mixed deciduous forest with teak at Mae-Huad as determined by soil aggregate**. Proceedings of the 3rd National Forestry Conference of Royal Forest Department, Bangkok: 1-12p.

Soil samples from A and B horizon were collected and total height and d.b.h. of all trees in plots are measured.

0109 Tinambunan, D. 1991. **Reduction of productive forest area and environmental disturbance due to hauling infrastructure construction in teak forest area**. (Indonesian). Duta Rimba 17(131/132): 33-38.

A report on the state of forest roads and railroads in teak forest in Cepu and Randablatung Forest Districts, Java. The erosion potential of the roads is considered to be low.

0110 Woraraksa, B. 1964. **Site quality of Lampang teak plantations**. (Thai). Student Thesis. Kasetsart University, Bangkok.

0111 Yang, Y.C; Wang, D.C (*et al*). 1970. **Site class studies on important tree plantations in Taiwan**. (Chinese; English). Taiwan University, Forestry Experiment, Technical Bulletin 80: 52p.

Describes studies of the relation between site factors and growth of teak and other species on plots in the main districts of Taiwan, including the development of site index curves adjusted for stand density by means of the crown competition factor and studies of the relation of site index to seven site factors, with tables for estimating the site index of unforested land on the basis of altitude, slope, and texture and depth of soil.

Go top

Undergrowth

(See also 3136, 3154, 3160)

0112 Anvery, S.A.A. 1940. **Grass and teak plantations**. Indian Forester 66: 285-286.

It is suggested that unchecked grass growth in teak plantations and the consequent soil impoverishment of nitrogenous matter, may be partly responsible for premature flowering and fruiting of teak and for the related phenomenon of lessening or stoppage of vegetative growth.

0113 Berger, L.G den. 1926. **Timber species from the growing areas of Java and Sumatra's east coast**. (Indonesian; English). Meded Proefsta Boschw 13: 186p. G. KOLEF and Company, Batavia.

0114 Beumee, J.G.B. 1919. **Small flora in teak forests**. (Indonesian; English). Tectona 12: 146-203.

0115 Beumee, J.G.B. 1922. **Analytical investigations of small flora in artificial teak plantations in Java in connection with development of teak stand**. (Indonesian; English). Dissertation, Agricultural University, Wageningen.

0116 Bhatia, K.K. 1959. **Teak bearing forests of old Madhya Pradesh**. Indian Forester 85(12): 710-722.

Detailed descriptions of the forests and their floristic composition.

0117 Champion, H.G. 1933. **Underplanting in teak plantations**. Indian Forester 59(5): 277-282.

The performance of underplanted crop of *Leucaena* is stressed. Trials of mixtures with *Dalbergia latifolia* is recommended, while listing *Swietenia macrophylla* and *Derris microphylla* as two of the successful species from twenty three species tried.

0118 Chandrasekharan, S; Sundarapandian, S; Chandrasekar, P; Swamy, P.S. 2001. **Exotic plant invasions in disturbed and man-modified forest ecosystems in the Western Ghats of Tamil Nadu**. Tropical forestry research: Challenges in the new millennium. Proceedings of the International Symposium, Peechi, India, 2-4 August, 2000, R.V. Varma; K.V. Bhat; E.M. Muralidharan; J.K. Sharma, Eds: 32-39. Kerala Forest Research Institute, Peechi.

The consequences of biotic activities with reference to exotic plant invasions were studied in natural forest and savannah and man-modified ecosystems including teak plantation and wastelands of the Western Ghats of Tamil Nadu.

0119 Chaubey, O.P; Mishra, G.P; Ram Prasad. 1988. **Phytosociological studies of teak plantations and mixed natural forests in Madhya Pradesh. II. Distribution, species diversity, productivity and some quantitative parameters of ground flora**. Journal of Tropical Forestry 4(2): 177-187.

The ground flora was studied using quadrates in an age range of teak plantations in 2 edapho-climatic regions of Madhya Pradesh and in their adjoining natural forests. Data are tabulated for each study site showing the importance value indices of the species found, numbers of species, total density, community coefficients between each plantation and its adjoining natural forest and above-ground biomass.

0120 Chaubey, O.P; Prasad, R; Mishra, G.P. 1988. **Studies of teak plantation and mixed natural forests in Madhya Pradesh**. Journal of Tropical Forestry 4(1): 22-35.

Comparative studies were made of floristic composition, species diversity and quantitative ecological parameters of frequency, density, basal area and importance value index. No discernable differences were found in the floristic composition of tree species under teak plantations and their adjoining natural forests. Total density and total basal area were also higher in teak plantations than in adjoining natural forests.

0121 Coster, C. 1933. **Root competition in the tropics, particularly regarding teak (*Tectona grandis* Linn.f.).** Indian Forester 59(10): 672-677.

0122 Coster, C. 1933. **Root studies in the tropics IV. Root competition**. (Dutch; German; English). Tectona 26(6).

It is found that the root competition of the old trees is the principal agent in retarding the growth of the teak plantation bordering an old forest. Teak is found very susceptible to root competition.

0123 Daryono, H. 1985. **Effects of age on the composition and development of teak (*Tectona grandis*) undergrowth flora**. Buletin Penelitian Hutan, Pusat Penelitian dan Pengembangan Hutan 469: 67-93.

Data are presented and analysed from 10-50 yr old plantations in Randublatung Forest District, Central Java.

0124 Das, A.P; Lahiri, A.K. 1990. **Angiospermic flora of Bethuadahari Reserve forest, Nadia (India)**. Indian Forester 116(11): 871-882.

The Bethuadahari Reserve in West Bengal is a deer sanctuary which has the appearance of a natural forest. The entire area was planted with different tree species including *Tectona grandis*. A pair of spotted deer, five sambars, thirteen spotted deer and three barking deer were released to the sanctuary. This study of the flora of the sanctuary was undertaken to ascertain the floristic composition in relation to controlled and open grazing and to determine the species grazed.

0125 Dawkins, H.C. 1956. ***Tectona grandis* as suppressor of *Imperata***. Forest Department, Uganda, Technical Note 16/56: p1.

All three plots of teak plantations were infested in the first four years after establishment, but were almost free after 7-8 years. Eight months after 30 percent thinnings, grass was increasing and though unlikely to regain its former vigour was sufficient to renew the fire hazard.

126 Eidmann, F.E. 1932. **Teak forests and undergrowth in Java**. Tectona 25(12): 1628-1675.

127

0127 Ganglo, J.C. 2001. **Study of the latitudinal gradients of the natural undergrowth of**

teak (*Tectona grandis*) plantations in south and central Benin. (French). Plant systematics and phytogeography for the understanding of African biodiversity. Proceedings of the XVIth AETFAT Congress, National Botanic Garden, Belgium, 28 August-2 September 2000. Systematics and Geography of Plants 71(2): 807-816.

A phytosociological assessment has been done in the natural undergrowth of teak plantations using the Braun-Blanquet approach in south and central Benin. The results help to identify three phytogeographical groups from south to north. The variance analysis of the phytogeographical types highlights significant gradients at 5 percent level of probability.

0128 Ganglo, J.C; Lejoly, J. 1999. **Biotope and ecological indicator value of the *Lecaniodiscus cupanioides* and *Landolphia calabarica* association in the natural understorey of the teak plantations of south Benin**. (French). Acta Botanica Gallica 146(3): 227-245.

The site characteristics and ecological indicator value of the plant community Landolphio-Lecaniodiscetum cupanioidis were studied in the natural understorey of the teak plantations of Djigbe forest in south Benin. The association is linked to the sites presenting the largest risks of wind throw, by reason of the shallow depth of the large roots.

0129 George, M; Varghese, G. 1989. **Phytosociology of Mudumalai forest vegetation continuum**. Journal of Tropical Forestry 5(1): 70-75.

The Mudumalai forest division is one of the most important reserved forests of Tamil Nadu because of its rich flora and wildlife. A preliminary survey of the forest had revealed the presence of various vegetation communities without boundaries, and this paper presents an analysis based on the continuum concept, with the variation in continuum index being correlated with a moisture gradient. Four main communities were identified which include *Tectona grandis*.

0130 Hadipoernomo. 1978. **The forest as source of traditional medicines**. (English; Indonesian). Duta Rimba 4(26): 56-60.

Modern processing and marketing have increased the popularity of traditional Javanese medicines both in Indonesia and abroad. The state forest enterprise Perhutani in 1976 began trials of growing medicinal herbs in Java as a ground layer in mature teak plantations, the method of cultivation and medicinal uses are briefly described for certain plants.

0131 Jafarsidik, Y; Sutomo, S. 1991. **Medicinal plants among the undergrowth of the teak forest and their use in traditional therapeutic practices in Bitakol, the buffer zone of the Baluran National Park, East Java**. (Indonesian). Buletin Penelitian Hutan 533: 37-46.

Medicinal plants constituted about 66 percent of the undergrowth in the teak forest at Bitakol in 1989. Tables are given listing the species found, with data on their density, frequency of occurrence, etc. Notes are given on some of the plants, its local names, description and utilization.

0132 Kant, S. 1997. **Integration of biodiversity conservation in tropical forest and economic development of local communities**. Journal of Sustainable Forestry 4(1/2): 33-61.

A methodology for quantification of the contribution of all non-timber forest products is suggested and applied to a sample of seven villages in India. A comparative analysis of the contributions of NTFPs in two major types of forest cover, teak and sal is made.

0133 Kapoor, S.L; Kapoor, L.D. 1973. **Further contribution to the flora of the Karimnagar District of Andhra Pradesh**. Bulletin of the Botanical Survey of India 15(1/2): 76-84.

The composition of the teak forests and the characteristic of the region is described, and a systematic list is given of sixty six species not previously recorded in the area.

0134 Korihalli, S.H. 1956. **A note on the optimum proportion of miscellaneous species in mixed teak (*Tectona grandis*) forests**. Proceedings of the 9th Silvicultural Conference, Dehra Dun 1956, Part I: 70-73.

Deals with deciduous forests of the western part of Mysore state where teak is an important species. Records composition of different teak forests and observes lack of natural regeneration and factors responsible for this situation. Methods to control and foster teak regeneration in these forests are given.

0135 Krishnaswamy, V.S. 1953. **Cover and nurse crops in sal and teak plantations at Dehra Dun**. Indian Forest Bulletin 185 (n.s.) Silviculture.

Describes Dehra Dun experiments on the growing of cover and nurse crops in sal and teak plantations, mainly with the object of improving impoverished soils of New Forest estate.

0136 Krishnaswamy, V.S; Puri, G.S. 1954. **Results of an experiment to study the succession of ground flora species under forest plantations raised on old agricultural land in the New Forest, Dehra Dun, India**. Indian Forester 80(9/10): 522-530.

Frequencies of ground vegetation were recorded in plantations including *Tectona grandis*. The data are examined and faults in the lay out of the plots are discussed.

0137 Luoma, J. 2002. **Understorey vegetation characteristics along teak (*Tectona grandis*) plantation/natural forest ecotones in Costa Rica**. Tropical Resources: Bulletin of the Yale Tropical Resources Institute 21: 11-16. Yale School of Forestry and Environmental Studies, New Haven, USA.

A study was conducted in the Parrita Valley in Costa Rica to examine the relationship between teak litter and understorey variables. Results showed that teak litter weights were very weakly correlated with understorey cover or species. Slope percentages had a positive correlation with teak litter weight.

0138 Mishra, T.K; Namta, B; Dehari, B; Banerjee, S.K. 1993. **Species diversity under sal and teak plantations in lateritic region**. Indian Journal of Tropical Biodiversity 1: 188-201.

0139 Nobles, R.W; Briscoe, C.B. 1966. **Mowing understorey vegetation in a young teak plantation**. (English; Spanish). United States Forest Service Research Notes, Institute of Tropical Forestry, Rio-Piedras ITF 9: 2p.

Mowing 1-4 times annually in 1963-66 to control *Panicum maximum*, *Leucaena glauca* and *Acacia macrantha* reduced fire danger but had not significant effect on d.b.h. or height increment of teak planted in 1956.

0140 Puri, G.S; Dabral, S.N. 1957. **Succession on ground flora species in the forest plantations of New-Forest, Dehra Dun**. Indian Forester 83(9): 551-554.

Deals with succession of ground flora in plantation including teak in New Forest, Dehra Dun.

0141 Rochmini S dan. 1983. **The teak cycle**. Duta Rimba 9(65/66): 21-25.

The definition of an optimum cycle in Indonesian teak forests is discussed in relation to their multiple benefits/products which include taungya crops, the production of wood other than teak, medicinal herbs etc.

0142 Ross, P. 1961. **The plant ecology of the teak plantations in Trinidad**. Ecology 42(2): 387-398.

An analysis of the vegetation invading teak plantations, based on transects through plantations established by taungya in 1938, 1943, 1948 and 1954 in broadleaved evergreen forest types.

0143 Saha, S. 2001. **Vegetation composition and structure of *Tectona grandis* plantations and dry deciduous forests in central India**. Forest Ecology and Management 148(1/3): 159-167.

Vegetation structure and composition of abandoned teak plantations was compared with the neighboring dry deciduous secondary forests in Madhya Pradesh. Species diversity and stem density were compared between plantations and secondary dry deciduous forests separately for adults and seedlings of trees, shrubs and lianas.

0144 Srivastava, V.K. 1986 . **Diversity and dominance in two man-made forests at Dehra Dun, India**. Indian Journal of Forestry 9(4): 287-292.

Number of species, the Shannon-Wiener index, Simpson's index, total basal area and total density and the importance value index were determined from the quadrate data. The diversity and dominance indices were inversely correlated in a curvilinear fashion in both plantations. Values are tabulated for basal area, importance value index and dominance index of each species in the two plantations.

0145 Thapliyal, M; Selvi, K.G; Lakshminarayan, U; Mohan, E. 2002. **A comparative study of ground flora of unilocational monoculture of *Acacia auriculiformis*, *Casuarina equisetifolia*, *Eucalyptus tereticornis* and *Tectona grandis* in Panampally, Palakkad District, Kerala.** Indian Journal of Forestry 25(1/2): 82-86.

This study was conducted on the ground flora of plantations including *Tectona grandis* in Panampally, Palakkad District of Kerala. A total of 59 species were recorded from the area.

0146 Thorenaar, A. 1929. **Uninterrupted covering of the forest floor**. Tectona 22: 318-320.

0147 Totey, N.G; Prasad, A; Kapoor, K.S; Nautiyal, S; Khatri, P.K; Bhowmik, A.K. 1989. **Studies on the growth performance of some green manure leguminous crops and their residual effect on the organic matter and available nutrients in eroded teak nursery soils of Nainpur**. Indian Forester 115(6): 404-413.

Growth measurements of the green manure crops were made after 30 and 60 days, and plant samples analysed for N, P and K. After 8 weeks the crops were ploughed in and allowed to decompose for 90 days. Soil samples were analysed before and after treatment for organic matter, and for available N, P and K, at 0-15 and 15-30 cm depths.

0148 Verma, R.K; Shadangi, D.K; Swain, D; Totey, N.G. 1996. **Status of plant diversity in Rajin preservation plot, Orissa**. Environment and Ecology 14(1): 227-234.

Data are tabulated on the synecological characteristics and regeneration of the preservation plot and a plot outside it, where forestry operations had continued. The index of diversity and index of dominance were higher in the preserved plot than in the unpreserved plot.

0149 Vora, A.B; George, V.C. 1987. **The distribution of various life forms in the ground flora under different canopies of Panchamahals forests, Gujarat, India**. Indian Journal of Forestry 10(3): 223-225.

Studies were made of the seasonal distribution of ground flora at five sites in different stages of canopy degradation, including three highly degraded forests, one conserved forest and one semi-degraded forest. Possible explanations and seasonal variations are discussed.

Go top

Animal and Birds

(See also 2121)

0150 Bell, H.L. 1979. **The effects on rain-forest birds of plantings of teak, *Tectona grandis*, in Papua New Guinea**. Australian Wildlife Research 6(3): 305-318.

Plantations of the introduced teak in New Guinea had little lateral branching, few epiphytes or climbers and little undergrowth. There were far fewer species of bird and mammal than in rain forest. A main food resource in teak was the teak moth, birds ate the larvae or pupae.

0151 Djuwantoka. 1991. **Habitat use of silver leaf monkey (*Semnopithecus auratus* E. Jeoffrey, 1812) in teak (*Tectona grandis* Linn.f.) plantation of Cepu, Central Java, Indonesia**. Philippines University College, Laguna, March 1991: 177 leaves.

A survey showed that six types of habitats in teak forest plantation were used by the Silver Leaf Monkey. Each habitat type had its own characteristics, structure and composition of vegetation which was distinguished from the other in terms of use by the Silver Leaf Monkey. This troop fed mainly on leaves, with the leaf petioles of teak leaves as the most preferred. Teak forest is deemed compatible with wildlife, particularly that of the silver leaf monkey.

0152 Gopal, R. 1988. **Effect of silvicultural practices on the status of wildlife: A case study in the Pench Sanctuary of Madhya Pradesh**. Journal of Tropical Forestry 4(1): 11-21.

The area studied was in the South Seoni Forest Division which contains three forest types which include moist teak forest and Southern Tropical Dry Deciduous teak bearing forest managed by 3 overlapping working circles for teak conversion, selection-cum-improvement and bamboo. Habitat relations were studied in selected thinning and main felling coupes.

0153 Hinde, R.J; Corti, G.R; Fanning, E; Jenkins, R.K.B. 2001. **Large mammals in miombo woodland, evergreen forest and a young teak (*Tectona grandis*) plantation in the Kilombero Valley, Tanzania**. African Journal of Ecology 39(3): 318-321.

This paper describes the frequency of large mammal use of evergreen forest, miombo woodland and teak plantation in the Kilombero Valley, Tanzania. Signs of small gleaners like duiker and bushbuck were most common in the teak plantation. The bulk feeders like elephant and buffalo avoid the teak plantation.

0154 Hsu, M.J; Agoramoorthy, G. 1996. **Conservation status of primates in Trinidad, West Indies**. Oryx 30(4): 285-291.

0155 Kotwal, P.C. 1987. **Vegetational studies in Noradehi Sanctuary, Madhya Pradesh with reference to wildlife management**. Journal of Tropical Forestry 3(3): 254-367.

Noradehi Wildlife Sanctuary was established in 1975 in dry deciduous teak forest. The most frequently occurring tree species were teak and *Terminalia tomentosa*. It is suggested that the sanctuary in future be maintained as a national park so that it can develop into a wilderness area.

0156 Lees, J.C; Kader, R.A; FAO. 1979. **The world's forests**. Forest and Timber 15(1): 21p.

A special issue of seven articles include an article entitled teak forests still the elephant's domain.

0157 Nair, P.V; Jayson, E.A. 1988. **Habitat utilization by large mammals in teak plantations and natural forests**. KFRI Research Report 56 (Summary): 11p. Kerala Forest Research Institute, Peechi.

An analysis was made of transects laid out in 1-, 3-, 16- and 62-year-old teak plantations and adjoining moist deciduous natural forest in the Parambikulam Wildlife Sanctuary in Kerala. The data were used to estimate resource availability, animal abundance, the extent of animal visits and type and amount of animal damage. It is suggested that damage by elephants could be reduced by mixing stretches of natural forests with different aged plantations.

0158 Perla, J; Finegan, B; Delgado, D. 2002. **Potential of teak and paja blanca for avifauna diversity conservation in Gatun lake subwatershed, Panama Canal**. (Spanish). Revista Forestal Centroamericana 38: 27-32.

A study is made to assess the role of teak plantations on bird diversity conservation in the tropical forest of the Gatun lake's sub-watershed, in the Panama Canal area. Bird population richness, abundance and diversity were evaluated in two teak plantations.

0159 Saxena, V.S. 1973. **Birding in Pratapgarh teak forests**. Indian Forester 100(7): 466-474.

The teak forests of Pratapgarh range, Chittorgarh Forest Division, Rajasthan, are described and 52 species of birds belonging to 42 genera and 25 families were observed.

0160 Sody, H.J.V. 1953. **Birds of the Javanese teak forest and a consideration of their value and damage in it**. (Dutch). Madj. Ilmu Al. unt. Indonesia 109(4/6): 125-720.

Lists 167 species reported in teak forests since 1853, with some indication of their food and to what extent they are dependent on the forest or are merely chance visitors, and discusses their value in insect control.

Go top

Soil Properties

(See also 0085, 0088, 0147, 0703, 2442, 2870, 3528)

0161 **Forest soils**. Indian Forester 68(10), 1942: 548-549.

Investigations showed that clay recovery from lateritic soils increased with fineness of grinding, the percentage increase from coarsest to finest grade, calculated on the basis of the non-clay fraction, giving some indication of the deterioration of the soil under teak. The formation and accumulation of clay, the removal of free silica and the accumulation of combined silica seem to render soil unsuitable for the growth of teak.

0162 **Forest soils**. Indian Forester 68, 1942: 329-332.

From soil analyses at Nilambur it is suggested that determination of the molecular ratios-SiO_2: R_2O_3, SiO_2: Al_2O_3 and SiO_2: Fe_2O_3-in the total soil may furnish a better index of lateritic condition and the suitability or non-suitability of the soil for teak.

0163 **Laterization of soil in teak plantations**. Forest Research India and Burma, Part 1, 1946: 86-89.

In deteriorating soils of teak plantations there is a tendency for sesquioxides to accumulate and silica to leach out. This feature and several topographical and morphological characteristics of the soil profile appear to influence the growth of teak.

0164 **Laterization of soil in teak plantations**. Forest Research India and Burma 1945-46, 1947: 92-100.

An attempt was made at forecasting the quality of teak soil to be expected after clear felling a natural forest and planting of teak.

0165 **Bibliography on soil requirements of forest trees 1940-1958**. Bibliographic Bureau of Soils, Harpenden 186, 1959: 34p.

Comprises 178 references with brief abstracts arranged by species, including teak and other tropical and sub-tropical species.

0166 Aborisade, K.D; Aweto, A.O. 1990. **Effects of exotic tree plantations of teak (*Tectona grandis*) and gmelina (*Gmelina arborea*) on a forest soil in south-western Nigeria**. Soil Use and Management 6(1): 43-45.

The properties of soil under 15-year-old plantations of gmelina and teak were compared with logged forest soil in southwestern Nigeria. The concentrations of total N, exchangeable Ca, Mg and K were greater under forest soil, but the concentrations of available P were similar under all three ecosystems.

0167 Adejuwon, J.O; Ekanade, O. 1988. **Soil changes consequent upon the replacement of tropical rain forest by plantations of *Gmelina arborea*, *Tectona grandis* and *Terminalia superba***. Journal of World Forest Resource Management 3(1): 47-59.

Fifteen years after tropical rain forest was replaced by plantations in the Ikere Forest Reserve, Ondo State, Nigeria, most soil properties were n.s.d. from those in rain forest despite significant differences in vegetation characteristics. The plantations, with high tree density and/or ground cover, are thought capable of protecting soil in a similar way to the rain forest.

0168 Adyalkar, P.G. 1973. **Hydrogeological control for teak and sal vegetation in parts of Maharashtra and Madhya Pradesh**. Current Science 42(16): 556-558.

Briefly reports studies since 1969, showing that in the Chandrapur District of Maharashtra, *Tectona grandis* grows well on sandy soil overlying pyroxene gneisses and associated quartz schist with breccias, and with a relatively deep water table.

0169 Akinsanmi, F.A; Akindele, S.O. 1994 . **Teak productivity in relation to soil conditions: A re-assessment of teak plantations in the dry high forest area of southwestern Nigeria.** Nigerian Journal of Forestry 24/25: 7-10.

A re-assessment of teak plantations in the dry high forest area of southwestern Nigeria was carried out by examining the relationship between stand volume and soil properties. Examined the changes which occurred as the plantations advance in age. The results of soil textural analyses showed stability over the years, while slight increases were observed in the organic matter content.

0170 Alexander, T.G; Balagopalan, M; Thomas, T.P; Mary, M.V. 1981. **Properties of soils under teak**. KFRI Research Report 7: 13p. Kerala Forest Research Institute, Peechi.

The project, properties of soils under teak, was started with the objective of evaluating changes in soil properties due to continuous teak cropping. Literature suggests that without proper soil management, clear-felling of natural or plantation forests and monoculture of teak may result in soil deterioration depending on the initial soil conditions, topography, climate and management practices. The profile data reveal recuperation of soil parameters during the long rotation of 60-70 years.

0171 Alexander, T.G; Sankar, S; Balagopalan, M; Thomas, T.P; Mary, M.V. 1984. **Soils in teak plantations of Konni, Naduvathumoozhi and Mannarappara Ranges of Konni Forest Division**. Working Plan for Konni Forest Division 1983-1993, Kerala Forest Department, Appendix: 1-21.

The teak enters into second and third rotations in Kerala. Results are presented of the soil investigation made in teak plantations of Konni, Naduvathumuzhi and Mannarappara ranges of Konni Division with the aim of optimum productivity.

0172 Alexander, T.G; Sankar, S; Balagopalan, M; Thomas, T.P. 1987. **Soil in teak plantations of different site qualities**. KFRI Research Report 45: 17p. Kerala Forest Research Institute, Peechi.

The site quality was calculated based on the height attainable at 50 yr old. Physical and chemical properties determined for different depths. Increases in gravel and exchange acidity and decreases in sand, silt, pH and exchangeable bases resulted in a lower SQ along transects. In a multiple linear regression analysis, soil variables accounted for 31 percent of the variation in top height, and age 63 percent. Partial regression coefficients indicated the important effects of gravel, sand, pH and exchange acidity.

0173 Amir Husni, M.S. 1984. **Detailed reconaissance soil survey of part of Bukit Perangin Forest Reserve and semi-detailed soil survey of Bukit Malut Forest Reserve, Pulau Langkawi, Kedah, for teak crop**. Forest Research Institute, Malaysia, Research Pamphlet 95: 60p.

A survey report on two areas in northern Malaysia where the climate is sufficiently seasonal for teak. The soils in the first area were formed on more or less metamorphosed sediments and granite on hilly lowland terrain, and in the second, less hilly area on Carboniferous sediments. A soil and terrain suitability classification for teak is presented and applied in maps.

0174 Amir Husni, M.S. 1998. **The preliminary performance of teak crop when planted on various soil types in Peninsular Malaysia**.

Malaysian Science and Technology Congress, Kuala Trengannu, Peninsular Malaysia.

0175 Amponsah, G.I; Meyer, W.L. 2000. **Soil characteristics in teak plantations and natural forests in Ashanti region, Ghana**. Communications in Soil Science and Plant Analysis 31(3/4): 355-373.

A study was made to compare soils of natural forests converted to teak plantations in the Offinso and Juaso Forest Districts in the Ashanti region, Ghana. Soil samples from the 0-20 and 20-40 cm depths were analysed for selected chemical and physical properties.

0176 Amponsah, G.I; Meyer, W.L; Murchison, H.G. 2000. **Soil sampling size estimates for soils under teak (*Tectona grandis* Linn.f.) plantations and natural forests in Ashanti region, Ghana**. Canadian Journal of Soil Science 80(2): 327-336.

Sites at Offinso and Juaso Forest Districts in the Ashanti region, Ghana, were used to study the variability patterns for selected physical and chemical properties. In each of three natural forest stands and three teak plantations, 16 soil pits were examined and soil samples from the 0-20 cm and 20-40 cm depths were analysed for selected chemical and physical properties.

0177 Ando, K. 2004. **The current situation of the demonstration study of forest management for carbon fixation**. Tropical Forestry 59: 12-23.

An account is given of a carbon sequestration demonstration study set up at various sites in Java and the species used include *Tectona grandis*.

0178 Arora, R.K. 1964. **The forests of North Kanara district II. Deciduous type**. Journal of Indian Botanical Society 43(1): 75-86.

Presents information on climate, soils, and species composition of teak mixed and bamboo mixed forest. Teak mixed forest flourishes in a comparatively drier climate than bamboo mixed forests. *Xylia* mixed forest has an edaphic status when it occurs in teak mixed forests. The trend of succession appears to be from teak mixed to bamboo/*Xylia*/*Terminalia* forest.

0179 Aweto, A.O. 1995. **Organic carbon diminution and estimates of carbon dioxide release from plantation soil**. Environ-mentalist 15(1): 10-15.

The rates of organic carbon diminution in the soil under different monospecific tree plantations including teak in Nigeria were investigated. The differences between the organic carbon status of their soils and soil under nearby natural rain forest vegetation were compared. The tree plantations released more carbon dioxide from the soil into the atmosphere than the natural forest.

0180 Balagopalan, M. 1986. **Soil properties in selected teak and eucalypt plantations of Trichur Forest Division, Kerala**. Annual Convention of Indian Society of Soil Science and National Seminar on Recent Advances on Soil Research and Special Seminar on Land Evaluation for Multipurpose Land-use Utilization, Coimbatore, September 1986: 2p.

A study was carried out in selected teak and eucalypt plantations of Trichur Forest Division, Kerala. Analysis were done for sand, silt, clay, soil pH, organic carbon, exchangeable bases and exchange acidity. Bulk density and percent of gravel were also determined.

0181 Balagopalan, M. 1987. **Effects of fire on soil properties in different forest ecosystems of Kulamavu, Kerala, India**. Malaysian Forester 50(1/2): 99-106.

A study was conducted to assess the effects of fire on soil chemical and textural properties in semi-evergreen and moist deciduous forests, grassland, and eucalypt and teak plantations. Fire had no noticeable effect on soil texture or pH, but changes were observed in organic carbon, exchangeable bases and exchangeable acidity. Soils in eucalypt plantations had higher organic carbon and lower exchangeable bases but these both decreased in teak.

0182 Balagopalan, M. 1989. **Physical and chemical properties of soils in eucalypt and teak plantations of Trivandrum Forest Division**. Proceedings of the First Kerala Science Congress, Cochin, 26-28 February 1989: 40-43. N.B. Nair, Ed. State Committee on Science, Technology and Environment, Thiruvananthapuram.

This paper highlights the nature and properties of soils in eucalypt and teak plantations of Trivandrum Forest Division. Soils are sandy loam and are strongly to very strongly acidic in the three depths of soils under eucalypt and teak. No pattern is followed in teak plantations in the case of gravel content. Organic carbon contents are relatively higher in eucalypt than in teak plantations. Little difference exists in pH, exchangable bases and exchange acidity of soils under eucalypt and teak.

0183 Balagopalan, M. 1989. **Properties of soils in the natural forests of Trivandrum Forest Division**. National Symposium on Forest Biology in the Service of Mankind and 9th Annual Meeting of Indian Society of Tree Scientists, Madurai, 5-6 January 1989.

0184 Balagopalan, M. 1995. **Changes in the distribution of organic carbon and different forms of nitrogen in soils under natural forest and teak plantations**. Proceedings of the 7th Kerala Science Congress, Palakkad, 27-29 January 1995: 110-112. P.K. Iyengar, Ed. State Committee on Science, Technology and Environment, Thiruvananthapuram.

In the case of plantations, texture was sandy loam in the 0-15 and 15-50 cm layers. Acidity, cation exchange capacity and organic carbon decreased with depth as well as in the sequence natural forest and teak plantations. It has been observed that all properties exhibited significant difference due to vegetational types.

0185 Balagopalan, M. 1995. **Effect of differences in forest cover on the variation in soil properties in Kerala, India**. Journal of Tropical Forestry 11(2): 125-131.

A study was carried out to evaluate the changes in soil properties in moist deciduous forest, anjili, teak and eucalypt, uncoppiced, I coppiced and II coppiced plantations in Kerala, India.

0186 Balagopalan, M. 1995. **Soil characteristics in natural forests and *Tectona grandis* and *Anacardium occidentale* plantations in Kerala, India**. Journal of Tropical Forest Science 7(4): 635-644.

This study was initiated to characterize the soils of natural forests and plantations of different species including teak in the Malayattoor Forest Division of Kerala. Soils in the teak plantation were loamy sand. Soils in the plantations were found to be deteriorated when compared to those in natural forests.

0187 Balagopalan, M; Alexander, T.G. 1983. **Organic matter dynamics in teak and eucalypt plantations**. KFRI Research Report 20: 21p. Kerala Forest Research Institute, Peechi.

An earlier version of a paper by the same authors already noticed by Journal of Tree Sciences 4(2), 1985: 13-20.

0188 Balagopalan, M; Alexander, T.G. 1984. **Soil organic carbon distribution along a transect through teak, eucalypt and albizia plantations in Kerala**. Journal of Tropical Forests 12: 33-37.

This study was initiated to evaluate organic carbon changes along a transect through plantations including teak in Kerala in relation to natural forests. Compared to natural forest, higher levels of organic carbon occurred in teak plantations. F-values were significant for the organic carbon values of locales in the transect.

0189 Balagopalan, M; Alexander, T.G. 1985. **Soil organic carbon distribution along transects in teak and eucalypt plantations**. Journal of Tree Sciences 4(2): 13-20.

Soil samples were analysed from 2.8-km transects along sequences of teak and eucalypt on well drained sites in Kerala. At Thora, a hilly site at 50-100 m altitude, organic carbon values in teak plantations remained close to those in natural forests. At Karulai OC content of the soil decreased along the sequence, which covered only one teak plantation, this is attributed to plantation operations in the early stages of a second rotation.

0190 Balagopalan, M; Chacko, K.C. 2001. **Growth of teak in successive rotations in relation to soil conditions**. KFRI Research Report 201: 26p. Kerala Forest Research Institute, Peechi.

A study was undertaken to examine the changes in soil conditions and evaluate the growth of teak in successive rotations. Gravel and organic carbon contents varied significantly between rotations, while for soil texture, pH, total N, available K and Ca, there was no significant difference between rotations. The discriminant analysis revealed that there was significant decline in soil fertility with change in rotation. The study suggests the need for careful management of the soil to reduce soil deterioration. Site specific soil erosion control measures and proper management of slash, weed and litter are recommended.

0191 Balagopalan, M; Jose, A.I. 1982. **Distribution of organic carbon and forms of nitrogen in soil under mahogany and teak**. Agricultural Research Journal of Kerala 20(2): 16-21.

A study was made on the influence of mahogany and teak vegetation on soil characteristics, namely, pH, organic carbon and different forms of nitrogen. Soils under teak were more acidic than those under mahogany. The content of organic matter decreased with depth. The C:N ratio of the soil was little influenced by depth as well as the type of vegetation.

0192 Balagopalan, M; Jose, A.I. 1982. **Dynamics of organic carbon and different forms of nitrogen under first and second rotation teak plantations of Kerala**. Agricultural Research Journal of Kerala 20(2): 92-97.

A study was conducted in first and second rotation teak plantations in Nilambur, Kerala on soil organic carbon and different forms of N. It was revealed that there was significant reduction in soil organic carbon and all forms of N in all layers of soil pits in the second rotation when compared with first rotation. The C:N ratio in soil under second rotation was found to be narrower as compared to that of the soil under first rotation. The depth-wise and rotation-wise distribution of available, ammoniacal and nitrate forms of N was similar to that of total N.

0193 Balagopalan, M; Jose, A.I. 1993. **Soil humic fractions of red ferrallitic soils as influenced by vegetational types**. Journal of Tropical Agriculture 31: 174-180.

0194 Balagopalan, M; Jose, A.I. 1997. **Effect of tree species on soil properties along a transect through teak, eucalypt and rubber in Kerala**. Teak: Proceedings of the Inter-national Teak Symposium, Thiruvana-nthapuram, Kerala, 2-4 December 1991: 236-241. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department and Kerala Forest Research Institute, Peechi.

A study was carried out to examine the effect of monoculture of teak, eucalypt, and rubber along a transect in Trichur Forest Division, Kerala. Analyses were carried out for particle size separates, soil pH, bulk density, water holding capacity, organic carbon, cation exchange capacity, total N, P, and S. Bulk density was increased, organic matter, N, P, S, and most cation nutrients were depleted in soils under monoculture plantations. Soils under teak were less deteriorated than that under eucalypt.

0195 Balagopalan, M; Rugmini, P. 1989. **Soil characteristics along a transect as influenced by teak plantations in Kerala, India**. Malaysian Forester 52: 67-74.

A study was carried out to find out the effect of teak plantation on soil characteristics in Trichur Forest Division, Kerala. On comparing soil properties in the three vegetational types, it was observed that silt, clay, water holding capacity, total N and S were highest in evergreen soils. Teak soils possessed highest values for sand, soil pH, Fe_2O_3 and Al_2O_3. There was significant difference in Fe_2O_3 and organic carbon contents between teak plantation and natural forests. The study manifests that soils in teak plantations were relatively more deteriorated in comparison to those under evergreen and moist deciduous forests.

0196 Balagopalan, M; Rugmini, P; Chand Basha, S. 1998. **Soil nutrient management for teak plantations of Kerala**. KFRI Research Report 138: 40p. Kerala Forest Research Institute, Peechi.

A project was undertaken to study the effect of different nutrients N, P, K, Ca and Mg on the growth of teak plantations belonging to different rotations. The study revealed that there was significant difference in increment in height of trees in younger plantations while increment in height, basal area and volume of trees in older plantations. Among the different treatments, comparison among means test showed that $N_2P_2K_2Ca_2Mg_2$ treatment was found to be the best in younger plantations.

0197 Balagopalan, M; Thomas, T.P; Mary, M.V; Sankar, S; Alexander, T.G. 1992. **Soil properties in teak, bombax and eucalypt plantations of Trichur Forest Division, Kerala**. Journal of Tropical Forest Science 5(1): 35-43.

Data are presented and discussed on the physical and chemical properties of soils under monocultures of teak and eucalyptus and mixed stands of teak and bombax. Chemical properties differed between plantations. The relatively low values for pH, organic carbon, exchangeable bases and exchange acidity in monocultural teak and eucalypt compared with those in mixed teak and bombax plantations necessitate positive measures in the former plantations to preserve and enhance soil fertility.

0198 Banerjee, A.K. 1973. **Nutritional experiment of *Tectona grandis* in laterite soils of West Bengal**. Silvicultural Conference, 6-10 December 1973, 50. Forest Research Institute, Dehra Dun.

A nutritional experiment of *Tectona grandis* with 5 levels of N, P, and K and with cowdung was taken up in the lateritic area of

West Bengal. Statistical analysis of height growth indicates, that addition of cowdung helps in boosting up of growth. Among the main effects, N. is significant at 1 percent level while NP interaction is also so.

0199 Banerjee, S.K; Nath, S; Banerjee, S.P. 1986. **Characteristics of the soils under different vegetations in the Tarai region of Kurseong Forest Division, West Bengal**. Journal of the Indian Society of Soil Science 34(2): 343-349.

A study of soil properties at three sites under different vegetation, but overlying almost similar parent material in West Bengal, reveals that there is considerable difference among the pedons primarily due to rooting and litter fall characteristics of the perennial vegetation they support. All the soils are acidic. Values of H+ are highest under mixed species, intermediate under sal and lowest under teak. Total bases at the surface soil under teak are highest but under mixed species much lower which may be attributed to differential recycling of elements under different species.

0200 Banerjee, S.P; Mathur, K.C; Prasad, K.G; Raina, A.K. 1989. **Clay minerals in the soils of South Kheri forests, Uttar Pradesh**. Indian Forester 115(8): 555-559.

X-ray diffraction of soil clays from 5 pedons selected in the South Kheri forests demonstrated that kaolinite was the dominant silicate material, both at the surface and sub-surface. In addition, small amounts of goethite, gibbsite and integrated micaceous minerals were identified. It is suggested that the occurrence of vermiculite only in the 3 pedons under natural sal, where it decreased in the sub-surface soil, may only be a coincidence. The other 2 pedons were under *Dalbergia sissoo* and Eucalyptus/*Tectona grandis*.

0201 Barrington, A.H.M. 1931. **Forest soil and vegetation in the Halaing Forest Circle, Burma**. Burma Forest Bulletin (Silviculture) 25.

The suitability of certain soil types for growing teak are given.

0202 Barrington, A.H.M. 1932. **Burma forest soils**. Indian Forester 58(10): 547-555.

In this study, the forest types are correlated in their distribution with F. Charlton's soil texture index number, except on soils with more than 10 percent of $CaCO_3$. Texture of top-soil is observed to influence species distribution and also limit their height growth depending on sharp changes in texture of successive soil-layers. Texture index number classes with site class sub-division and important associated and indicator species are given for the forest types characterised by their dominant species amongst which teak and four other species find place.

0203 Basuki, T.M; Triwilaida; Gintings, A.N. 1996. **Effect of *Hopea odorata*, *Tectona grandis*, *Vatica* sp., and *Hopea mengarawan* on soil properties and nutrient content on the forest floor**. Buletin Penelitian Hutan 601: 65-74.

The effects of *Hopea odorata*, *Tectona grandis*, *Vatica* sp., and *Hopea mengarawan* plantations on soil properties and forest floor nutrient were studied. Soil pH of the stands was acid, with the highest soil pH under *Tectona grandis*. All the stands had a good soil organic matter content, but poor nitrogen and phosphorus contents. *Tectona grandis* showed the lowest uptake of nitrogen and potassium but the highest uptake of calcium. The implications of the results for choice of species on acid soils and fertilizer practices are noted.

0204 Beekman, H. 1917. **Soil and forest**. (Indonesian; English). Tectona 10: 153-175.

0205 Beumee-Nieuwland, N. 1917. **Report on an examination of some soils of marl origin from teak forests**. (Indonesian; English). Tectona 10: 176-203.

0206 Beumee-Nieuwland, N. 1918. **Report on examination of red soils from teak forests**. (Indonesian; English). Tectona 11: 187-205.

0207 Beumee-Nieuwland, N. 1922. **Soil investigations in teak forests in Java**. Meded Proefsta Boschw 8: 92p.

Sets out the results of chemical and physical analysis of teak soils. The majority of the teak forests occur on tertiary lime soils, but some fine stands are found on soils of volcanic origin. The relation of the carbonate of lime content to the nature of the forests is discussed.

0208 Beumee-Nieuwland, N. 1923. **Soil, in teak forests of Java**. International Institute of Agriculture Monthly Bulletin 1(1): 86p.

0209 Bhatia, K.K. 1954. **Calcium a factor in the ecology of teak (*Tectona grandis* Linn.f.)**. Proceedings of National Academy of Sciences, December 1954, Allahabad 24B(4): 159-163.

Values are given for percent ash, CaO and exchangeable Ca in teak foliage from July to January. Ca runs from 3.6 percent which supports the theory that teak is a Cal-ciphyte. Thus the Ca status of forest soils should be considered in teak quality forecasts.

0210 Bhatia, K.K. 1955. **Foliar calcium of teak**. Journal of Indian Botanical Society 34(3): 227-234.

Investigations were made on native teak at Sagar to study: (1) variations in amounts of foliar Ca with respect to soil pH and exchangeable Ca in the soil, (2) variations in the uptake as affected by age, and (3) seasonal variations of foliar Ca. In the first two cases no definite correlation could be established; but a gradual tendency was found for the percentage of foliar Ca to increase with the advance of the growing season.

0211 Bhowmik, A.K; Totey, N.G. 1990. **Characteristics of some soils under teak forests**. Journal of the Indian Society of Soil Science 38(3): 481-487.

Soils of the natural forest of Bori, Madhya Pradesh, are slightly acidic to neutral. Their organic matter content is high at the surface and gradually decreases down the profile. Ca is more recycled than Mg from lower to A horizons. High Ca:Mg ratios in upper layers relative to lower ones indicate the active role of teak in pedogenesis. The soils are classified as Mollisols.

0212 Bloch, P. 1958. **Thailand forest soils**. Natural History Bulletin of the Siam Society 19: 45-55.

The paper describes chemical composition of teak soils. In spite of high clay fraction the soil is well drained, the teak soils have high humus content; 3.39 percent in top layer to 1.07 percent at 1.6 m depth as compared to 1.34 percent in top payer in non-teak soils. The C/N ratio is very low in the deeper layers of teak soils indicating that plenty of N-must be freely available to the roots. The teak soils are typical lateritic soils, and there is good supply of P. which increases with depth.

0213 Boonchai, K. 1965. **Study on the fertility of soils in the teak plantation of Nakorn Rajima**. (Thailand). Student Thesis. Kasetsart University, Bangkok.

The fertility status has not been different in different soils examined and there is no depletion of phosphorous in the soils.

0214 Bruin, J.H.S. 1972. **Development of forest resources, Togo. Soil survey of certain sectors of south Togo**. (French). FAO Report SF-TOG 10, Rapport Technique 4: 160p.

Gives detailed results of a soil survey in several regions where reforestation is envisaged, and discusses choice of location for trial plots and nurseries. Studies are also described on the soil relations of *Terminalia superba* and *Tectona grandis*.

0215 Castens, H.E. 1927. **An investigation of the soil conditions in compartment I, Bwet reserve. Prome division, with reference to the dying of the *Tectona grandis***. Burma Forest Bulletin 18: 14p.

After an examination of soils and forests of teak areas where dying of teak was observed, analysis of dead and living trees and crops, and also ring counting in young taungya areas, the author comments on different soil conditions. Root systems of teak in different soils are described and various soils types are illustrated.

0216 Castens, H.E. 1933. **Soil deterioration in pure teak plantations**. Indian Forest Records (Silviculture Series) 59(10): 656-659.

The difficulties experienced in regenerating old Nilambur teak plantations are discussed and change in soil properties are slow and cannot be easily compared plantation teak with natural teak in view of long rotation and slow process of soil change and development. The author advocates (1) determination of fundamental nature of teak soils, (2) factors determining the quality of teak soils and (3) carry out a large measure soil survey and analysis for both inside and outside teak areas.

0217 Chacko, K.C; Sankar, S; Pandalai, R.C; Nandakumar, U.N. 1989. **Studies on the effect of slash burning on planting site for teak**. KFRI Research Report 61: 21p. Kerala Forest Research Institute, Peechi.

An extensive field trial was conducted at Mundakadavu, Karulai Range, Nilambur Forest Division, Kerala, to study the effect of slash burning on soil properties, weed growth, taungya yield and growth of teak in a second rotation plantation. Burning reduced weed growth during the first three months after planting, but not significantly after this.

0218 Chacko, K.C; Sankar, S; Pandalai, R.C; Nandakumar, U.N. 1991. **Effects of slash burning on soil properties, weed growth, taungya yield and growth of teak**. Indian Forester 117(4): 237-248.

Studies on the effect of slash burning on planting site for teak is studied in which teak was raised in a second rotation plantation with rice and gingelly as the first year taungya crops in Nilambur Forest Division, Kerala. It is found that taungya yields and teak survival and growth were not significantly affected by the different treatments in which involved removal and burning of different sized slash and teak survival and growth was not affected by the practice of taungya. Treatment effects on soil chemistry and weed growth were transitory.

0219 Chamshama, S.A.O; Mugasha, A.G; Sanga, J.M. 2000. **Comparison of some chemical properties of soil under teak and natural forests at Mtibwa, Morogoro, Tanzania**. Journal of Tropical Forest Science 12(1): 92-103.

Soil chemical properties were compared of natural forests and first rotation teak plantations at Mtibwa Forest Project, Morogoro, Tanzania. Soil samples were analysed for pH, electrical conductivity, total N, available P and exchangeable cations. The results of this study suggest that there is a need for continued monitoring of soil chemical properties in teak plantations since there are indications of changes in soil properties.

0220 Chaubey, A.K; Singh, S.B; Prasad, K.G. 1991. **Prediction of soil properties under different forest ecosystems based on discriminant analysis**. Van Vigyan 29(1): 28-34.

An attempt is made to devise model to predict soil properties under four forest types, viz. sal coppice forests, teak dominated sal coppice forests, teak plantations and plantations of mixed species of teak, sal and *Eucalyptus tereticornis* in the lateritic belt of West Bengal. Organic carbon, humus carbon, humic acid, fulvic acid, exchangeable calcium and exchangeable magnesium values from each vegetation community were used to calculate multiple discriminant functions and subjected to cluster analysis.

0221 Chavan, K.N; Kenjale, R.Y; Chavan, A.S. 1995. **Effect of forest tree species on properties of lateritic soil**. Journal of the Indian Society of Soil Science 43(1): 43-46. Oxford & IBH Publications, New Delhi.

It was found that forest tree species including teak in ten-year-old plantations at Wakawali, Maharashtra did not change the soil physical properties under the canopy, but there were marked effects on the soil chemical properties compared with natural forest soils. Organic carbon, available nitrogen, phosphorus and potassium increased significantly in the surface layer. The CEC and exchangeable cations also increased due to the decomposition of organic matter added through leaf litter. Calcium was the dominant cation.

0222 Choldumrongkul, S; Hutacharern, C. 1990. **Study on soil and properties of teak tree in relation to the number of beeholes**. Proceedings of IUFRO Workshop on Pests and Diseases of Forest Plantations, Bangkok, 5-11 June 1988: 149-154. K.G. MacDicken; M.H. Ivory; K.S.S. Nair, Eds.

Sampled trees were measured for girth at breast height. Soil around the sampled trees and their barks were analysed for constituents. The following soil properties exhibited the positive correlation with the beehole class silt, clay, pH, phosphorus, potassium and calcium.

0223 Chongsuksantikun, P; Tantiraphan, W. 1991. **Study on relationship between some soil properties and growth of *Tectona grandis*.** Vanasarn 49(4): 38-41.

Soil properties of individual plots at the depth of 0-18, 18-50 and 50-100 cm were evaluated. Dbh of teak related to soil parameters as follows; pH, available P, exchangeable Ca, base saturation and cation exchange capacity. The better growth of teak of dbh 7.88-11.02 cm was found when the pH of soil was moderately acid to near neutral with medium to very high available P, high to very high exchangeable Ca, medium to high base saturation and high to very high cation exchange capacity.

0224 Choubey, O.P; Prasad, R; Mishra, G.P. 1987. **Studies of the soils under teak plantations and natural forests of Madhya Pradesh**. Journal of Tropical Forestry 3(3): 235-238.

A study was made of soil properties in five teak plantations aged 2-3 to 56 year and in their adjoining mixed natural forests in two edaphoclimatic areas of the state. Surface soil samples were analysed for pH, electrical conductivity, organic C, and available N, P and K. The pH under teak plantations was slightly lower than under the adjoining natural forest; pH under both areas decreased with increasing age of the plantation. Organic C, and N, P and K were higher under the teak plantations than under the adjoining forest, but values of each tended to increase with age of plantation.

0225 Clarson, D; Mythili, S. 1998. **Evaluation of soil fertility status in teak plantations of south India**. Indian Forester 124(2): 146-149.

The available macronutrient status and the physicochemical properties of the soil in commercial teak plantations were evaluated at four sites in Tamil Nadu and one in Andhra Pradesh. The nitrogen, phosphorus and potassium status of the plantations were low to medium, low, and medium to high, respectively. It is suggested that soil fertility evaluation could form the basis for better discriminatory fertilizer recommendation for growing teak plantations in India, so that soil fertility status could be maintained and teak production made sustainable.

0226 Classen, J.C van R. 1909. **Is teak harmful to the soil?** (Indonesian; English). Tectona 1: 575-580.

0227 Contractor, R.M; Badanur, V.P. 1996. **Effect of forest vegetation on properties of a Vertisol**. Journal of the Indian Society of Soil Science 44(3): 510-511.

On the basis of the effects of different tree plantations in the properties of a Vertisol teak, *Acacia nilotica*, *Tamarindus indica* and neem were found the most suitable species for growing in the dry tract of Karnataka, India.

0228 Copleston, W.E. 1919. **Importance of soil aeration for teak**. Indian Forester 45(2): 82-84.

Need and importance of mulching to keep soil free of weeds and plants, to secure loosening and aeration of soil by worms and insects, and to protect seedlings from root competition of weeds and drought following after rains are pointed out as chief advantages.

0229 Dabral, B.G; Pande, S.K. 1980. **Soil moisture regime under forest plantations**. Indian Forest Records, Silvics 3(1): 46p.

Soil samples were taken from plantations of teak, chir and bamboo and under grass, at New Forest, Dehra Dun for testing. Tables and graphs give meteorological data, soil characteristics and various data on soil water. In general moisture content under plantations increased with depth with maximum values in August and minimum values in May. Soil moisture behaviour was similar in chir, teak and sal.

0230 Dabral, B.G; Yadav, J.S.P; Sharma, D.R. 1965. **Soil moisture studies in Chir pine, teak and sal plantations at New Forest, Dehra Dun**. Indian Forester 91(10): 701-713.

Presents data from soil-moisture studies in *Pinus longifolia*, *Shorea robusta* and *Tectona grandis* plantations. Results indicate that the highest soil moisture content were found at 2-3 ft. for teak plantations. It appears that soil moisture is influenced as much by the physical, chemical and biological properties of the soil as by the species growing in it.

0231 Dagar, J.C; Mongia, A.D; Singh, N.T. 1995. **Degradation of tropical rain forest soils upon replacement with plantations and arable crops in Andaman and Nicobar Islands in India**. Tropical Ecology 36(1): 89-101.

The areas cleared for commercial plantation and agricultural use in the islands showed significant decrease in soil pH, organic matter, extractable P and exchangeable K contents and increased bulk density. Nutrient cycling and water balance were negatively affected by the monoculture of commercial plantations including *Tectona grandis* and cultivation of arable crops.

0232 Das, M; Singh, B.P; Khan, S.K. 1997. **Effect of forest tree species on properties of acid alfisol on sloping land in Meghalaya**. Annals of Agricultural Research 18(4): 441-446.

0233 Datta, M. 1996. **Potassium changes in soil upon incorporation of leaf prunings of multipurpose tree species in an acid soil of Tripura**. Journal of the Indian Society of Soil Science 44(3) 398-401.

Water soluble and exchangeable soil potassium initially increased and then declined in the 2-4 months after incorporation of fresh leaf prunings of multipurpose forest tree species at a rate of 10 t/ha. Compared to the control, the initial high free energy values observed in all the leaf prunings, besides Acacia leaves, could indicate enhanced K availability. A similar increase in nutrient potential for K in the soil solution was recorded.

0234 Datta, M; Dhiman, K.R. 2001. **Effect of some multipurpose trees on soil properties and crop productivity in Tripura area**. Journal of the Indian Society of Soil Science 49(3): 511-515.

Growth and yield characteristics are given for twelve multipurpose trees including teak planted at 4 x 4 m spacing.

0235 Davis, P.W. 1940. **Preliminary note on Nilambur soils with special reference to their suitability for teak**. Indian Forester 66: 658-671.

Teak plantations in Malabar, on soils that had borne good mixed forest containing fine teak and with all the indications of a good site for this species, tending to stagnate after a time or even to be invaded by more tolerant species that replace the teak. The soil is of gneissic origin, and the climate, with alternating periods of heavy rain and great heat and drought, presents conditions favourable for the formation of laterite *in situ* on exposure or through any act that reduces the humus content of the soil.

0236 Dhanmanonda, P. 1970. **Determination of aggregate sizes in different ages of plantation at Huay Tak**. (Thai). Faculty of Forestry, Kasetsart University, Thailand, Forest Research Bulletin 12: 21p.

0237 Dhar, B.L; Banerjee, S.P. 1981. **Sand mineralogy of soils under natural teak in Maharashtra**. Van Vigyan 19(1): 14-22.

Analysis of the fine sand fractions of 4 representative soil profiles suggested that the sediments were derived from acid igneous and metamorphic rocks. The soil could not be typified by any particular mineral and the near absence of easily weatherable minerals and abundant concentration of iron ores indicated intense weathering before deposition or during soil formation. Over-exploitation of such soil could lead to rapid site degradation.

0238 Dhar, B.L; Jha, M.N; Banerjee, S.P; Kukretee, S.P. 1984. **Clay mineralogy of some teak bearing soils of Maharashtra**. Indian Forester 110(7): 662-672.

Illite and kaolinite have been found to be widespread as major clay minerals in some teak bearing soils of South Chanda Forest Division. It is suggested that kaolinization results in a loss of bases which is not adequately compensated by nutrient cycling. It is therefore necessary to guard against over-exploitation, so as to protect the soil and preserve the ecosystem.

0239 Dhar, B.L; Jha, M.N; Kukretee, S.P. 1988. **Sand mineralogy as an indicator of soil fertility in forest soils under teak (*Tectona grandis*).** Journal of Tropical Forestry 4(1): 47-52.

Four soil profiles under teak were studied for mineralogy of sand fractions by petrographic techniques. Quartz was the most abundant light mineral in all the profiles. Based on the preponderance of various heavy minerals, soil profiles were characterised by tourmaline, epidote/pyroxenes, epidote/tourmaline/biotite and biotite/hornblende/epidote mineral assemblages.

0240 Dhar, B.L; Jha, M.N; Suri, S; Singh, K. 1992. **Minerology and nutrient status of teak-growing soils**. Journal of the Indian Society of Soil Science 40(1): 156-161.

The sand mineralogy and total and available nutrient status of Udic and Typic Ustochrept pedons from Madhya Pradesh were studied and the results are discussed in relation to the growth of teak on these soils.

0241 Dimri, B.M; Singh, S.B; Banerjee, S.K; Singh, S.B. 1987 . **Relation of age and dominance of tree species with soil chemical attributes in Kalimpong and Kurseong Divisions of West Bengal**. Indian Forester 113(4): 307-311.

Soil samples were collected from 1X1 m pedons in 8 plantations of either sal, sal dominated by teak, or teak dominated by sal, age 11-102 year. Soil parent material and topographic and climatic characteristics were similar in all sites. Plants in 40X40 m quadrats were measured for d.b.h. and height Soil samples were analysed for pH, organic matter, extractable Ca and Mg, and N and K. Soil pH varied widely between sites, and attempts are made to relate this to age and species type or mix and to the fact that a greater amount of soil Ca is found in teak sites.

0242 Drechsel, P; Schmall, S; Zech, W. 1989. **Mineral nutrition and soil properties in young teak plantations in Benin and Liberia**. Mitteilungen der Deutschen Bodenkundlichen Gesellschaft 59(2): 691-696.

The nutritional status and growth of young teak plantations was related to soil types and topography. On Ferralsols and Gleysols in Liberia growth and deficiency symptoms were correlated with position on the slope, with slowest growth and most severe dieback occurring on gleyic bottom soils. Vigour of Liberian teak was mainly related to topsoil acidity and the foliar Ca-status on Ferralsols.

0243 Drechsel, P; Schmall, S; Zech, W. 1990. **Relationships between growth, mineral nutrition and soils in young teak plantations in Benin and Liberia**. Water, Air and Soil Pollution 54(1): 651-656.

0244 Edelman, C.H. 1941. **Studies on the soil science of the Netherlands-Indies**. (Dutch). Publ. Stichting `Fonds Landbouw Export Bureau 1916-1918', Wageningen 24 416p.

A comprehensive review of relevant literature comprising chapters on soils of different species. A separate chapter on forest soils dealing mainly with teak stands.

0245 Ezenwa, M.I.S. 1988. **Edaphic factors affecting the growth of *Tectona grandis* on basaltic soils in the derived savanna area of Nigeria.** Geo Eco Tropical 12(1/4): 125-132.

The relationship between soil properties and growth of 11-year old teak was studied on 15 sample plots in plantations at Nimbia, Kaduna State, Nigeria. It was observed that effective soil depth, total nitrogen, exchangeable Ca and K and total exchangeable bases were positively correlated with tree heights and basal areas. The implications of the findings for site selection and forest management in Nigerian savannas are discussed.

0246 Fluyt, P.C.M. 1946. **Notes on forestry in Siam**. (Dutch). Tectona 36(4): 215-230.

Brief general notes on geography, climate and people, followed by an account of the forests of the northern part of the country is given. Teak is claimed to be in its optimum environment and to attain its greatest dimensions in N. Siam. Data on height, clear bole and girth at various ages are tabulated. The teak forests are State owned. Before the war 85 percent. of the exploitation was by European firms, 14 percent by native concerns and only one percent by the Government itself. Increasingly strict regulation has had to be imposed to safeguard the yield. The Brandis Selection System is used as in Burma. Brief notes are included on girdling, felling, transport grading and conversion.

0247 Freezaillah bin Che Yeom. 1965. **Soil survey/assessment for the extension of teak planting in the Chuchok Valley, Mata Ayer Forest Reserve, Perlis**. Malaysian Forester 28(3): 230-239.

Presents the results of a reconnaissance soil survey to assess the area suitable for further planting of *Tectona grandis* in the locality, in view of the success of the existing limited plantations. Relevant literature on teak/soil relationships is listed.

0248 Gangopadhyay, S.K; Banerjee, S.K. 1987. **The influence of vegetation on the properties of the soils of Sikkim**. Proceedings of the Indian National Science Academy. Part B Biological Sciences 53(3): 283-288.

A study of the influence of different tree species including *Tectona grandis* on the characteristics of the soils of Sikkim at 300-1690 m altitude is made. Ash of green foliage, litter and raw humus was analysed for the oxides of elements present to determine the changes taking place during the transformation of green foliage to litter and then to raw humus. It was observed that during the transformation some of the elements like Ca, Mg, K, Na and P were leached out while others like Si and Fe were accumulated.

0249 Gangopadhyay, S.K; Das, P.K; Nath, S; Banerjee, S.K. 1989. **Pedogenic characteristics of the soils supporting different forest vegetation in the Foot Hill Region**. Journal of the Indian Society of Soil Science 37(4): 775-891.

The physicochemical characteristics of soils under different vegetation sequences in the tarai region of Darjeeling district were studied. The soils of the area are mainly Inceptisols, Mollisols and Ultisols. Base saturation of the surface soil is highest under *Tectona grandis*. Haplustolls and Hapludolls represent a better habitat type for the growth of *Tectona grandis*.

0250 Gangopadhyay, S.K; Das, P.K; Nath, S; Banerjee, S.K. 1992. **Forms and distribution of potassium in forest soils of Sikkim**. Indian Journal of Forestry 15(4): 306-312.

Different forms of K were investigated in soils of Sikkim Forest Division under 8 types of forest cover in the lower, middle and upper hills. Soils were acidic and organic carbon and CEC were also high. Data are reported for water soluble, exchangeable, fixed, HCl soluble and lattice K. Content of different forms of soil K varied under different vegetation.

0251 Gangopadhyay, S.K; Nath, S; Banerjee, S.K. 1987. **Nature and properties of some introduced teak (*Tectona grandis*) growing soils of North-West Bengal**. Indian Forester 113(1): 65-72.

Vegetation was studied by quadrate analysis. Numbers of trees were counted, and girth at b.h. and total height recorded. Data are tabulated showing average height, d.b.h., and basal area and tree numbers per ha for each site. Theoretical values for d.b.h. and basal area are also given, based on a diametre growth curve constructed from a yield table for the area. Teak was growing well at all sites, indicating that the soils on them were favourable for the species. The results of physical and chemical analyses of the soils are presented and indicate suitable ranges of various characteristics for optimum growth.

0252 George, M; Gupta, G.N. 1988. **Soil-vegetation relationship in a tropical deciduous forest of Western Ghat**. Journal of Tropical Forestry 4(4): 387-394.

The study area was in Nilgiri North Division, Tamil Nadu, and was grouped into 3 rainfall regions of 750, 750-1500 and 1500-2500 mm p.a. The floristics of each region were studied by quadrate analysis and Importance Value Indices are given for the dominant species. Three different vegetation communities were identified The results are tabulated and indicate that characteristics like soil texture, depth, pH, P, Ca and organic carbon content show significant variation between communities. Maximum depth of the A horizon was recorded in the *Tectona grandis*/*Anogeissus latifolia* community.

0253 Ghani, Q. 1951. **Effect of teak plantations on the soils of the evergreen and semi-evergreen forests of East Bengal**. Pakistan Journal of Forestry 1(4): 342-347.

The author is of the opinion that the soils in the semi-evergreen forests are in a delicate balance between the two opposing processes of podzolization and laterization and great caution should be exercised before altering the balance by converting the semi-evergreen forest to teak.

0254 Ghani, Q. 1951. **Some problems in the working of the evergreen and semi-evergreen forests of East Bengal**. Pakistan Journal of Forestry 1(3): 204-208.

Discusses difficulties of extraction and utilization of the evergreen and semi-evergreen forests of Chittagong and the Chittagong Hill Tracts and possible disadvantages in the present policy of planting felled areas in this region with teak, both because of the danger of provoking laterization and/or erosion of the soil by substituting deciduous for evergreen cover, and because of the trend towards using more wood as pulp, plywood and fibreboard and less as sawn timber.

0255 Ghare, D.K; Khare, P.K; Mishra, G.P. 1985. **Effects of forest fire on soil nutrient level in a *Tectona grandis* forest stand**. Ecology and resource management in tropics Vol. 1: 71-75. K.C. Misra, Ed. Bhargava Book Depot, Varanasi, India.

0256 Glaser, B; Drechsel, P. 1992. **Relations between available soil phosphate and the foliar phosphate contents of *Tectona grandis* (teak) in West Africa**. (German). Zeitschrift fur Pflanzenernahrung und Bodenkunde 155(2): 115-119.

Studies were made in teak plantations on a wide range of soils in Togo, Benin, Liberia, and Cote d'Ivoire to analyse significant correlations between foliar P and topsoil P contents. Teak trees generally have an adequate P supply with 300-320 kg/ha P and soil depth 15 cm, i.e. above about 150 mg P/kg in stone-free topsoil, in the study region between Benin and Liberia.

0257 Griffith, A.L; Gupta, R.S. 1948. **Soils in relation to teak with special reference to laterisation**. Indian Forest Bulletin 141: 58p.

A general review of the previous literature on the subject is given, which appears to suggest that in teak plantations there occurs a deterioration of the soil with the lowering of the site quality. It has been suggested that laterization of the soil may be one of the factors responsible for this deterioration. The present investigation was undertaken to test the truth of this theory, and find some simple index by which to recognize teak soils.

0258 Gulam Chand; Pathak, T.C. 1972. **Some soil factors in relation to man made forests with special reference to teak**. Proceedings of Symposium on Man-made Forests in India, 8-10 June 1972: III D-49 to III D-53. Society of Indian Foresters, Dehra Dun.

From the field and laboratory investigations of soil from Chittapur, Andhra Pradesh teak plantations, it has been concluded that textural variation in the sub-soil seems to be a significant soil factor responsible for poor growth of 1968 plantation.

0259 Gupta, G.N; Prasad, K.G; Mohan, S; George, M. 1988. **Effect of soil texture and rainfall on stocking and growth of naturally occurring tree species**. Van Vigyan 26(1/2): 35-42.

Soil profile and vegetation studies were carried out in 366 soil pedons and quadrats in Coimbatore Forest Division, Tamil Nadu. The data collected included soil texture, rainfall, numbers of trees/ha for different species and their girth, density and basal area. Five species which include *Tectona grandis* were very sensitive to coarse textured soils and grew better on those of medium texture.

0260 Gupta, R.S. 1946. **Laterisation of soils in teak plantations**. Proceedings of the 7th Silvicultural Conference, Dehra Dun, 1946: 436-444; Indian Forest Bulletin 141, 1947.

0261 Gupta, R.S. 1956. **On the suitability of soils for teak plantations with special reference to laterization**. Proceedings of the 8th silviculture Conference, Dehra Dun, 1951, Part 2: 266-269.

An experiment is conducted to determine the effect of planting pure teak on forest soils with a tendency to laterization. Preliminary results indicate that there is little change in the chemical nature of the soil. In particular, the SiO_2/R_2O_3 ratio, which is the index of laterization of soil, shows the same trends under both natural forest and teak plantation.

0262 Hamilton, J.D. 1927. **Conclusions based on a geological examination of teak-bearing rocks in Burma**. Indian Forester 53(2): 88-91.

After a study of Burma rocks over a decade the author suggested that finer soil of older aluminum are considered home of natural teak, teak is distributed on these deposits and holds and flourishes depending on soil depth. He also suggested conditions required for establishment of teak e.g. soil moisture, soil texture, similar to older alluvium, drainage and correlates distribution of teak to geological formations. The problem of regeneration and effects of fires and calcicolus habit of teak are also discussed.

0263 Hase, H. 1981. **Nutrient reserves in sites of the Caparo Forest Reserve, Venezuela with special emphasis on teak (*Tectona grandis*) plantations.** Gottinger Bodenkundliche Berichte 66: 152p.

Biomass production of the plantations was inversely correlated with clay content of the soil. Nutrient reserves were higher under teak plantations and secondary forest than under natural forest because of nutrient introduction and burning treatments. The former soils contained 90 of the total N, P and Mg reserves and 50-90 of the total K.

0264 Hase, H; Foelster, H. 1983. **Impact of plantation forestry with teak (*Tectona grandis*) on the nutrient status of young alluvial soils in West Venezuela**. Forest Ecology and Management 6(1): 33-57.

Biomass and inventories of macronutrients were determined for ten teak plantations and a mature forest stand which preceded them. Mean tree and stratified random sampling methods of estimating biomass were compared with regression estimates. The average yearly production of biomass per ha of the teak plantations was greater on sites with soils having higher clay contents.

0265 Hoque, S.M.S; Hossain, A.T.M.E; Islam, A.T.M.N; De, H.B. 1989. **Characterization of forest soils of seed orchard and adjoining teak plantation at Hyanko**. Bano Biggyan Patrika 18(1/2): 18-25.

A soil survey was carried out at Hyanko, Chittagong District, Bangladesh to study the soils under seed orchard and the teak and *Gmelina arborea* plantations. The aim was to determine site capability for different forest tree species.

0266 Hosur, G.C; Dasog, G.S. 1995. **Effect of tree species on soil properties**. Journal of the Indian Society of Soil Science 43(2): 256-259.

The influence of tree plantations which include *Tectona grandis* on the properties of red loam soil in Karnataka, India was investigated. Tree planting decreased bulk density and pH whereas soil aggregation, organic matter and exchangeable calcium of the soils increased. The nutrient status of the soils was little changed by tree plantations. The nutrient return through litterfall followed the order Ca N K in teak.

0267 Ikojo, H.A. 1983**. Study of the effect of *Gmelina arborea* (Roxb.) and *Tectona grandis* (L. f.) plantations on the microbial and chemical properties of Onigambari soil. Thesis Summary**. Forestry Abstracts 44(10): 605-606.

0268 Jaski, K.C. 1910. **Is there now any working plan whereby poor soils may be brought under cultivation etc?** (Dutch). Tectona 2: 339-344.

0269 Jenkin, R.N. 1962. **A report on teak soils**. Department of Forest Research, Nigeria, Technical Note 15.

0270 Jeyamala, M; Soman, P. 1999. **Short term changes in soil fertility status in intensively managed teak plantations**. Indian Journal of Forestry 22(1/2): 106-111.

The soil nutrient dynamics was investigated in two of the large experimental teak plantations of Sterling Tree Magnum in Coimbatore, Tamil Nadu during the early period of growth. The plantations were 2.5 and 3 yr old, and changes in the soil chemical characteristics were measured over a 1.5 yr interval. Account was taken of the fertilizers applied and the nutrients returned by litter fall

0271 Jha, M.N; Gupta, M.K; Dimri, B.M. 1999. **Soil organic matter status under different social forestry plantations**. Indian Forester 125(9): 883-890.

A study was conducted in Langha Forest Range, Mussoorie Forest Division, Uttar Pradesh in plantations including teak to determine forest influences on the status of soil organic matter. This study was conducted before and after the monsoon to investigate changes in SOM due to change of seasons.

0272 Jha, M.N; Gupta, M.K; Dimri, B.M; Bedwal, H.S. 1999. **Soil moisture accretion with progressive rainfall under *Tectona grandis* (teak) and Eucalyptus plantations.** Indian Forester 125(4): 392-400.

The gradual accretion of soil moisture with cumulative rainfall was studied at different depths under *Tectona grandis* and *Eucalyptus* plantations in the Langha Range, Mussoorie Forest Division, Uttar Pradesh.

0273 Jha, M.N; Gupta, M.K; Dimri, B.M; Bedwal, H.S. 2001. **Moisture distribution pattern in the soil under different tree plantations**. Indian Forester 127(4): 443-449.

The soil moisture distribution pattern in soil profiles under *Pinus roxburghii*, teak, *Dalbergia sissoo*, *Eucalyptus hybrid* , *Acacia catechu* plantations, *Shorea robusta* and barren land was studied. Soil was loamy sand under teak.

0274 Jha, M.N; Gupta, M.K; Pandey, R. 2000. **Factor analysis of soil nutrient distribution pattern under different plantations**. Indian Forester 126(12): 1270-1278.

Five plantations were selected including teak in the Mussoorie Forest Division, Uttar Pradesh and a factor analysis was conducted to identify the underlying patterns of nutrient and soil chemical properties. The four factor model explained 90 percent of the variance in total P, 85 percent of the variance in organic matter and available N and 70 percent of the variance in total N, total P and total Na, available K and available P. It also explained 62 percent of the variance in available potassium and 66 percent of variance in total Ca.

0275 Jha, M.N; Pande, P. 1980. **Loss of soil moisture as affected by decomposing leaf litter of different forest species**. Indian Forester 106(5): 352-356.

Air-dried soil samples were collected from stands of different species including teak growing on silty clay and clay loams in Uttar Pradesh, and mixed in pots with 10 or 20 percent of the corresponding dried leaf litter. The pots were regularly watered and water loss was measured over 120 days.

0276 Jha, M.N; Rathor, A.K.S. 1984. **Soil organic matter in biomass determinations**. Indian Forester 110(9): 895-900.

Data are presented relating to different species including teak grown at Dehra Dun, showing that soil organic matter is frequently great in proportion to total biomass; available figures range from approximately 17 to 76.5 percent.

0277 Jingsungnern, P. 1967. **Some physical and chemical properties of soil in the natural teak forests of Mae-Huad forest, Nagao, Lampang**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Not much difference was observed in physical and chemical properties of teak grown in good and poor sites, hence these properties cannot be used to classify soil depth.

0278 Joeswopranjoto, S. 1957. **Soil studies on teak forests and teak plantations including physical, chemical and micro-biological aspects in Indonesia**. FAO Teak Sub-Commission, Bandung FAO/TSC-57/24: 4p. FAO, Rome.

In order to correlate the site quality with tree growth in teak forest areas, the chemical, physical and microbiological aspects of forest soils were studies in detail. The termite hill soils and their chemical composition are studied in detail and the future problem of study of teak forest soils and the need for preparation of a soil map for each teak forest division are discussed.

0279 Jose, A.I; Koshy, M.M. 1972. **A study of the morphological, physical and chemical characteristics of soils as influenced by teak vegetation**. Indian Forester 98(6): 338-348.

Describes a study in Kerala of the morphological and physical characteristics of soils in natural forest and in teak plantations on sites formerly occupied by natural forest. The natural forest and the oldest teak plantation had a distinct surface horizon rich in organic matter. The organic matter in soil samples from three different depths down to 180 cm was correlated with the age of the plantations.

0280 Joshi, S.R. 1964. **Character of some Madhya Pradesh forest soils**. Journal of Indian Botanical Society 43(1): 1-8.

The soil profiles of miscellaneous forest are fresh, immature, and rich in minerals; under teak they are immature to slightly mature; and under sal lime-deficient and probably formed by laterization.

0281 Kadambi, K. 1951. **Geology of teak in Mysore**. Proceedings of the 8th Silvicultural Conference, Dehra Dun, 1951, Part 2 (1956): 239-242.

The paper shows how the distribution of teak in Mysore state can be understood by a study of the geology of the areas where it occurs, and how its absence from most parts of Hassan district can be properly explained by studying the nature of the underlying rock.

0282 Kaewcharoen, M. 1965. **Study on soils of different site qualities in teak plantation**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Study of soils from five different site classes based on height 15m, 12-15m, 9-12m, 6-9m and 6m has been done. Soil is sandy loam in all cases and properties of soil are same eventhough teak has different heights.

0283 Kaewla-Iad, T. 1968. **Some physical properties of soil in teak plantations of different ages at Mae-Huat, Lampang**. (Thai). Student Thesis. Kasetsart University, Bangkok.

No differences were observed in physical properties of soil from A and B horizons.

0284 Kaitpraneet, W; Thaiutsa, B. 1975. **Some chemical properties of soil at Klangdong Teak plantation Nakornrachasima province**. (Thai). Faculty of Forestry, Kasetsart University, Thailand, Research Note 15: 11p.

Chemical analysis of 9 samples of surface soil from 1-, 8- and 15-year-old *Tectona grandis* plantations showed that organic matter content increased significantly with age; pH, cation exchange capacity, P, K, Mg and Ca did not vary significantly with age.

0285 Kamala, B.S; Angadi, V.G; Parthasarathi, K; Rai, S.N. 1986. **Symptoms of deficiency of trace elements and the associated changes in peroxidase isoenzyme pattern in the seedlings of teak, mahogany and Eucalyptus**. Van Vigyan 24(3/4): 49-55.

Symptoms of deficiency of copper, zinc, manganese, molybdenum and boron, and the associated changes in the peroxidase isoenzyme pattern are described in seedlings including *Tectona grandis*.

0286 Kaul, O.N; Sharma, D.C; Tandon, V.N; Srivastava, P.B.L. 1979. **Organic matter and plant nutrients in a teak (*Tectona grandis*) plantation**. Indian Forester 105(8): 573-582.

Estimates were made by (a) the mean tree and (b) the stratified tree methods of the DM production and nutrient content of a 0.364-ha plot of teak at Dehra Dun, India. The plot, 38 yr old, had 152 trees of very variable size. Data are tabulated on fresh and dry wt. of leaves, twigs, branches, stem and bark, and the N, P, K, Ca and Mg contents of each. For all quantities, values obtained by (a) were 25-30 lower than by (b): m.a.i. of non-photosynthetic biomass was 2.4 t/ha by (a) and 3.3 t/ha by (b).

0287 Kerbert, H.J. 1909. **Is teak harmful to soil?** Tectona 2(1): 44-46.

0288 Khare, D.K; Khare, P.K; Mishra, G.P. 1982. **Effect of heat on nutrient release from soil under tropical dry deciduous forest**. Japanese Journal of Ecology 32(1): 107-110.

Soil samples from various topographical areas of a tropical dry deciduous forest stand dominated by teak were heated for five minutes at temperatures of 100 or 200 deg C in an oven and at 300, 400, 500 or 600 deg C in a muffle furnace. The samples were cooled to room temperature and analysed. A rapid increase in pH at temperatures up to 200-300 deg C, increases in exchangeable K and Ca and losses in total nitrogen were observed.

0289 Khemnark, C; Wacharakitti, S; Aksornroae, S; Kawelaiad, T. 1972. **Forest production and soil fertility at Nikhem Doi Chiangdao, Chiangmai Province**. (Thai). Forest Research Bulletin 22: 44p. Kasetsart University, Bangkok.

After study of land use policy in dry mixed deciduous forests with teak, recommendations were made on treatment of each forest ecotype to ensure maximum value at maturity.

0290 Khobragade, N; Matte, D.B; Patil, B.N; Gabhane, V.V; Pagar, P.C. 2000. **Effect of plant densities and age of teak on major nutrient status of soil**. PKV Research Journal 24(2): 112-113.

A study was conducted in Nagpur, Maharashtra to characterize the properties of soil under teak plantation having two age groups and different spacing. Closer spacing and age of teak plantation increased the total nitrogen content. Phosphorus content was increased in the narrow spacing. The various spacing and age of teak plantation showed an increase in available potassium.

0291 Laurie, M.V. 1931. **Teak and its lime requirements**. Indian Forester 57(8): 377-381.

The author reports his observations from Annamalai Hills, Madras and offers a testing ground of Hemilton's theory, with alternating patches of magnificent teak and mixed forests and also presents the soil analysis data of the proposed area, which have more uniformity than enunciated by Hamilton. He concludes that lime in itself cannot be regarded as a necessity for good teak growth and physical factor of soil may account for it.

0292 Mapa, R.B. 1995. **Effect of reforestation using *Tectona grandis* on infiltration and soil water retention.** Forest Ecology and Management 77(1/3): 119-125.

This paper reports on the effects of reforestation using teak on infiltration and soil water retention of a Rhodudult in Sri Lanka. Adjacent sites were studied in an area which had been cleared for cultivation over 50 yrs ago. The sites were cultivated and reforested with teak 12 yr ago. Results showed that the afforestation site has the highest steady infiltration rate, due to better soil structure and more macro-pores created by root activity and high organic matter content. The soil water retention was highest in the reforested soil at both depths studied

0293 Marquez, O. 1994. **Mapping soils and evaluation of teak (*Tectona grandis*) plantations in unit II of the Ticoporo forest reserve.** (Spanish). Revista Forestal Venezolana 28(38): 17-23.

Soil types were classified under teak plantations in the western lowlands of Venezuela. Soil fertility was medium to low and drainage was poor. Yield of teak was greatest for plantations on Typic/Fluventic Eutropept soils. These were characterized by a silty loam upper horizon and loamy lower horizons. Teak yield decreased as clay content increased in the soil.

0294 Marquez, O; Hernandez, R; Torres, A; Franco, W. 1993. **Changes in the physicochemical properties of soils in a chronosequence of *Tectona grandis***. Turrialba 43(1): 37-41.

Rehabilitation measures carried out in close cooperation with the local community since 1988 are described in 4230.7 ha of degraded teak forest in Sewu range, South Gombong, Java. The measures involved agroforestry and social forestry techniques. The effect of a teak chronosequence on soil properties was studied in the Ticoporo Forest Reserve, Venezuela. Ca and Mg contents, pH and cation exchange capacity were significantly higher in the soils of the 12-year-old plantation than in the younger plantations

0295 Mohr, E.C.J. 1922. **Samples of soil from several forest districts of the forest service**. (Dutch). Tectona 4: 125-151.

0296 Mongia, A.D; Bandyopadhyay, A.K. 1992. **Distribution of different forms of copper under different vegetations**. Journal of the Indian Society of Soil Science 40(4): 851-853.

Copper was extracted from soil horizons under six kinds of vegetation: evergreen forest, semi-evergreen forest, deciduous forest, rubber, teak and *Pterocarpus dalbergioides* in the Andaman and Nicobar Islands, India. Extractable copper was higher under plantation than natural forest and decreased with depth.

0297 Mongia, A.D; Bandyopadhyay, A.K. 1992. **Physico chemical changes occurring in soils of tropical forest after clearfelling for high value plantation crops**. Journal of the Indian Society of Soil Science 40(3): 420-424.

Soil physicochemical changes that occurred following the replacement of tropical rain forest with high value plantation crops were studied on South Andaman and Little Andaman islands, India. Profile water content, water storage and the water intake rate were lower under teak, red oil palm and *Pterocarpus dalbergioides* compared with virgin forest. Organic matter, Bray's P and available K decreased and bulk density increased when forest was replaced by plantation crops.

0298 Mongia, A.D; Bandyopadhyay, A.K. 1993. **Effect of soil iron and manganese on teak mortality grown in South Andaman**. Journal of the Indian Society of Soil Science 41(1): 199-201.

Reports a study carried out near Tushnabad on the relation between available Fe and Mn of representative soils and teak mortality. Teak mortality was minimum at sites which had a relatively lower available

Fe content in the surface horizon, and a higher content in the subsurface soils; a decrease in the subsurface soil content of available Fe resulted in increased mortality. Teak mortality is related to a decrease in available Fe and Mn, especially in subsurface horizons.

0299 Murthy, M.S. 1971. **Is teak (*Tectona grandis*) a calcicole?** Current Science 40(12): 324-325.

A study of the growth and dominance of teak in eleven associations in Madhya Pradesh in relation to the amount of exchangeable Ca in the underlying soils revealed no evidence that soil Ca plays a decisive role in the growth and distribution of this species.

0300 Murugesh, M; Srinivasan, V.M; Rai, R.S.V; Parthiban, K.T. 1999. **Teak (*Tectona grandis* Linn.f.) on farm land and its effect on soil fertility**. Advances in Horticulture and Forestry 6: 153-161.

Soil samples were collected at depths of 0-15, 16-30 and 31-45 cm from irrigated teak stands, age 6, 8 and 10 years, at the Forest College and Research Institute, Mettupalayam, Tamil Nadu. Soil samples were also collected from a cultivated agricultural field and a barren site. In comparison to both fallow and agricultural soil, increased EC and decreased soil pH were observed under 10-year-old teak. Organic matter and available N, P and K were higher in all teak stands than in the barren site. Exchangeable Ca and Mg were generally greater at all ages of teak than in fallow and agricultural soils. The chemical properties showed similar changes with depth in all soils.

0301 Myers, W.N. 1937. **The assessment of site quality in teak forest soils in connection with soil surveys**. (Dutch). Agriculture School, Wageningen: 156p.

0302 Najib Lotfy, A; Amir Husni, M.S; Suhaimi, W.C; Krishnapillay, B. 2002. **Soil and timber plantations**. A manual for forest plantation establishment in Malaysia: 25-32. Forest Research Institute Malaysia, Kuala Lumpur, Malaysia.

0303 Nath, S; Banerjee, M; Chattoraj, G; Ganguly, S.K; Das, P.K; Banerjee, S.K. 1988. **Changes in soil attributes consequent upon differences in forest cover in a plantation area**. Journal of the Indian Society of Soil Science 36(3): 515-521.

The effect of vegetation change on soil properties was studied in a contiguous area of the Kalimpong Division of West Bengal. There was a significant increase in pH and base saturation of the soil under teak after 12 years. After 28 years, pH and base saturation further increased and thus the soil was transformed from Inceptisol to Mollisol at the order level. pH and base saturation of soils increased under *Tectona grandis*.

0304 Noor, H.M. 2003. **Growth of teak (*Tectona grandis*) on lateritic soil at Mata Ayer Forest Reserve, Perlis.** Journal of Tropical Forest Science 15(1): 190-198.

Teak stumps were transplanted in a lateritic site at Mata Ayer Forest Reserve, Perlis, Malaysia. Maximum height and diameter increments were reached at ages four to five years after planting. Recommendations to improve the survival and productivity of teak grown on lateritic soils are given.

0305 Nwoboshi, L.C. 1972. **Differential influences of two exotic forest tree species on a soil**. Journal of the West African Science Association 17(1): 35-47.

Two young creep soils which in the past were pedologically similar were investigated after a 30 year period under plantations of *Cassia siamea* and *Tectona grandis*. The two profiles were morphologically indistinguishable, but texturally the surface horizons tended to have a crumb structure under cassia and a subangular type of structure under teak. Soil organic matter contents and C/N ratio of both the plantations were also studied.

0306 Nwoboshi, L.C. 1975. **Macronutrient deficiency symptoms in teak (*Tectona grandis* Linn.f.)**. Bulletin, Department of Forest Resources Management, University of Ibadan 6: 12p.

Teak seedlings and stump plants were grown in pots in sand watered with either a complete nutrient solution or solutions complete except for N, P, K, Ca, Mg or S. After 14 weeks, measurements were made of: seedling height and diameter; number and surface area of leaves; dry weight of leaves, stems, roots, the above-ground portion, and the whole plant; and root/shoot and stem/foliage ratios. The general appearance, vigour and leaf colour of the trees were recorded. The results are discussed, and a key based on visual symptoms is given for identifying each major-nutrient deficiency.

0307 Nwoboshi, L.C; Rosswall, T. 1980. **Nitrogen cycling in a teak plantation ecosystem in Nigeria**. Nitrogen cycling in West African ecosystems: 353-361. SCOPE/UNEP International Nitrogen Unit, Royal Swedish Academy of Sciences, Stockholm, Sweden.

0308 Ogigirigi, M.A; Igboanugo, A.B.I. 1985. **Root growth characteristics of some exotic and indigenous tree species in the Nigerian savanna**. Pakistan Journal of Forestry 35(3): 97-103.

Roots were exposed by digging trenches in 3 zones of varying soil type and moisture. Root size and distribution were recorded at 0-30, 30-60, 60-90 and 90 cm deep and beyond. All soil types had a layer of hard iron crust at a depth of 40-60 cm. Roots of *Tectona grandis* was able to penetrate beyond the plinth. Roots of all trees grew better at Nimbia, where the plinth layer was pisolitic, softening in the wet allowing more root penetration than on the other sites where the plinth layers were continuously hard.

0309 Okojie, L.O. 1997. **Bush burning and termite infestation: Implications for environmental accounting in Nimbia Forest Reserve**. Nigerian Journal of Forestry 27(1/2): 37-39.

Investigated the incidence of bush burning in the largest teak plantation in Nimbia Forest Reserve, Nigeria and its impact on termite infestation. A very high and significant correlation was found to exist between bush burning and termite infestation.

0310 Okoro, S.P.A; Aighewi, I.T; Osagie, C.O. 1999. **Effects of selected monoculture plantation species on the humid tropical soils of Southern Nigeria.** Nigerian Journal of Forestry 29(1/2): 73-79.

This study was initiated to investigate the effects of different monoculture plantation species on some soil physical and chemical properties in the lowland rain forest belt of South-western Nigeria. The 28-year-old even-aged contiguous monoculture plantations of *Tectona grandis* along with *Terminalia ivorensis*, *Nauclea diderrichii* and *Gmelina arborea*, including a natural forest as control, were studied. The results showed that the conversion of the natural tropical forest to monoculture species resulted in significant loss of soil calcium and available phosphorus.

0311 Okoro, S.P.A; Aighewi, I.T; Osagie, C.O. 2000. **Effect of selected monoculture plantation species on the humid tropical soils of southern Nigeria**. Indian Journal of Agricultural Sciences 70(2): 105-109.

A study was conducted in 1997 to investigate the effect of different monoculture plantation species including teak on physical and chemical properties of soil in the lowland rain forest belt of southwestern Nigeria. The conversion of the natural tropical forest to monoculture species resulted in significant losses in soil calcium and available phosphorus. The effective cation exchange capacity, pH, magnesium content and texture of the soil were not affected by the respective plantation species. Significant variation of some of the properties with depth was observed for plantation soils.

0312 Osumi, Y. 1979. **Site classification based on soil in northern Malaysia**. Tropical Agriculture Research Series 12: 119-123.

A soil survey was conducted in the Mata Ayer Forest Reserve of Northern Malaysia to assess suitable sites for the establishment of plantations of species including *Tectona grandis* and indigenous tree species. The suitability of each soil unit for the growth of particular tree species is indicated.

0313 Pande, P.K; Sharma, S.C. 1994. **Seasonal variations in carbohydrate activities in soils of some tropical plantations**. Tropical Ecology 35(2): 253-262.

Monthly variations in the activities of amylase, cellulase and invertase were studied in soils under plantations including teak at Dehra Dun, India. Invertase activity was consistently higher throughout the year than the activities of the other two enzymes. Amylase activity was variable.

0314 Pandit, B.R; Chava, S.R.K; Rao, V.V.S.V. 1988. **Differences in chemical properties of soil under different forest covers in two ranges of the South Dangs forest division (Gujarat)**. Advances in Plant Sciences 1(1): 15-20.

Alterations in chemical properties of soils developed on the same slope but supporting different forest associations (teak + *Terminalia tomentosa* at Pimpri and teak + *Dalbergia latifolia* at Chichinagoan) were investigated in the South Dangs forest region, Gujarat.

0315 Pandit, B.R; Prasannakumar, P.G; Jana, C.K. 1997. **Seasonal variations in lead content in Dangs forest, Gujarat**. Advances in Plant Sciences 10(2): 145-148.

Tectona grandis, *Terminalia tomentosa* and *Dalbergia latifolia* were sampled for lead content at 3 sites in Danga forest, Gujarat, India, in the summer, winter and monsoon seasons. Different plant tissues and litter were analysed and lead content in soil at different depths was also determined. Leaves of *Tectona grandis* contained most lead during winter at Chinchinagaon.

0316 Panicker, V.R. 1997. **Tropical soil and teak culture - a new silvi system**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 70-72. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Conolly's plot at Nilambur and Bourdillon's plot at Arienkavu, Kerala, are the living monuments which commemorate the pioneering efforts of Sri. Chathu Menon and Mr. T.F. Bourdilon, in teak culture. The silvicultural system being practised for teak is clear-felling, slash burring and planting. The pre-planting as well as post-planting operations including taungya in teak plantation are largely responsible for the large scale erosion of fertile top soil and thereby deterioration of site quality. A new silvicultural system for teak by adopting modified pre-planting operations, planting, and tending techniques is suggested for improving the soil fertility and reducing the soil erosion.

0317 Paoprachak, P. 1967. **The influence of aspects on soil moisture contents in teak plantations**. (Thai). Student Thesis. Kasetsart University, Bangkok.

N-aspect has significantly more moisture than E, S and W - aspects. Slopes with 3, 6, 9 and 12 percent have significantly more moisture content to 15 percent slope. Moisture content in soil and growth decrease when slope increases.

0318 Parthiban, K.T; Rai, R.S.V. 1994. **Effects of a few plant species on soil physical properties**. Journal of Tropical Forest Science 6(3): 223-229.

Seven multipurpose tree species including *Tectona grandis* raised as woodlots in a farmer's holding at Coimbatore, Tamil Nadu were investigated for their effects on soil physical properties relative to a site without vegetation and to a cultivated soil. Compared with the cultivated field, a degeneration in soil physical properties was associated with tree species. Bulk density increased under *T. grandis*.

0319 Parthiban, K.T; Rai, R.S.V. 1994. **Trees on farmlands - their effects on soil fertility**. Annals of Forestry 2(1): 44-51.

Soil fertility was compared under seven tree species including *Tectona grandis* raised as woodlots on a farmer's holding in Tamil Nadu, and on a vegetationless site and a cultivated field in the proximity. Compared with the uncultivated soil, organic carbon was more under tree species except for *L. leucocephala*. N, P and K under tree cover registered an increase.

0320 Prasad, A; Khatri, P.K; Bhowmik, A.K; Totey, N.G. 1990. **Relationship of teak mortality in Khandwa (Madhya Pradesh) and available soil iron and manganese**. Journal of the Indian Society of Soil Science 38(1): 174-176.

Analytical data are reported and discussed for three soil profiles in one compartment of natural teak forest, each exhibiting different mortality percentages.

0321 Prasad, J; Gaikwad, S.T. 1991. **Site characteristics of soils supporting teak (*T. grandis*) and sal (*S. robusta*) of Mandla District, Madhya Pradesh**. Van Vigyan 29(3): 180-181.

Soil characteristics are described under teak - developed over basalt and sal - developed over gneiss.

0322 Prasad, K.G; Singh, S.B; Gupta, G.N; George, M. 1985. **Studies on changes in soil properties under different vegetations**. Indian Forester 111(10): 794-801.

Soils were sampled in the Coimbatore Forest Region, Tamil Nadu, India below natural forest and teak plantations, 40 yr after conversion. Physical and chemical properties of soil were analysed. Soil organic C, P_2O_5 and Mg concentration were lowest under the teak and intermediate under the mixed plantation.

0323 Prathummanee, Ch. 1961. **Correlation between teak growth during 10 years and the depth of the B-horizon**. (Thai). Student Thesis. Kasetsart University, Bangkok.

After examining soils from 20 pits in teak plantation Mae Huat, Lampang, it is found that the growth of teak is correlated to the depth of B-horizon significantly.

0324 Pricha Dhanm Anonda. 1973. **Site quality of mixed deciduous forest with teak at Mae Huad, Lampang, as determined by soil aggregate**. Forest Research Bulletin, Faculty of

Forestry, Kasetsart University, Thailand 27: 34p.

Site quality was determined from estimates of biomass derived from height and dbh measurements. Soil samples were taken from A and B horizons, and dry-sieved to find the proportion of aggregates in four size classes. No statistical relation could be found between biomass and soil aggregates.

0325 Puri, G.S. 1954. **Soil climate of some Indian forests**. Journal of Indian Botanical Society 33(4): 394-416.

A study was made of soil moisture, organic matter, relative humidity, temperature, pH, and exchangeable Ca in plantations of *Pinus longifolia*, sal and teak in the New Forest, Dehra Dun, and in a grassy area in the open, during the dry summer, monsoon rain, dry winter and rainy winter periods. There were indications of the existence of a relationship between pH, Ca content, temperature and soil r.h. and the tree cover. Highest pH values were found under teak. Lower temperatures at all depths were found in hot weather under teak and sal.

0326 Qureshi, I.M; Yadav, J.S.P. 1977. **Results of some studies on the forest soils of India and their practical importance**. Proceedings of the 11th Silvicultural Conference, Dehra Dun, 15-25 May 1967: 194-203. Forest Research Institute, Dehra Dun.

Notes on work on the soils of dry zone areas, tropical moist evergreen forests, the Himalayan region, various recently afforested areas, forests of *Shorea robusta*, teak and bamboo and *Casuarina* and eucalypt plantations.

0327 Raina, A.K; Banerjee, S.P; Pharasi, S.C; Prasad, K.G. 1990. **Clay minerals in the alluvial sediments in a part of Indo-Gangetic Plain**. Van Vigyan 28(4): 129-135.

X-ray diffraction and chemical data are reported from analyses of five selected clay soils in the South Kheri forests of Uttar Pradesh, three under *Shorea robusta*, one under *Dalbergia sissoo* and one under a Eucalyptus/*Tectona grandis* plantation. Kaolinite was the dominant silicaceous mineral with small amounts of integrated micaceous minerals in the clay fractions.

0328 Ram, N; Jana, M.M. 1997. **Ecological impact of compaction under teak plantation in the foothill of Darjeeling Himalaya**. Indian Forester 123(7): 623-630.

The effects were studied of compaction of the soil under a teak plantation in the Darjeeling Himalayan foothills of West Bengal. Two areas were surveyed one near a village and subjected to compaction by livestock, vehicles, forestry operations, etc. and the other an adjacent non-compacted site. In the compacted area, decreases in height, diameter and basal area of teak were noted.

0329 Ram, N; Patel, S. 1992. **Infiltration capacity of compacted soil under teak plantation**. Van Vigyan 30(2): 77-80.

Measurements made in a 21-year-old teak plantation in West Bengal, where the forest floor had undergone compaction due to excessive biotic interference, gave values for bulk density, porosity, initial infiltration. The intake of water under compacted conditions was less than one third of that of a normal forest floor after a time lapse of 180 minutes.

0330 Rana, B.S; Parihar, A.K.S; Singh, B.P. 2002. **Growth pattern of certain MPTS raised on sodic land**. Indian Forester 128(6): 674-680.

An experiment was conducted in Faizabad, Uttar Pradesh to study the growth performance of thirteen multipurpose tree species including teak raised on sodic land.

0331 Rao, B.R.M; Iyer, H.S. 1981. **Suitability rating of Barnawapara soils for teak plantation**. Van Vigyan 19(4): 115-122.

A soil survey was made in Raipur district, Madhya Pradesh, using 1:15 000 scale aerial photographs and field checks. Physical and chemical properties of the soils, topography, drainage conditions and slope and soil depth were used to rate the soils into four suitability classes. Highly suitable sites included forested crests and side slopes of granitic undulating plain and foot slopes of denudational hills.

0332 Rathod, R; Devar, K.V. 2003. **Effect of different plantations on soil chemical properties**. Karnataka Journal of Agricultural Sciences 16(3): 485-486.

A study was conducted in Karnataka to determine the changes in the chemical properties of soils under plantations of different species including teak. It is found that soil pH was low under all plantations except *A. mangium*.

0333 Rathod, R; Devar, K.V. 2003. **Effect of different plantations on soil physical properties**. Karnataka Journal of Agricultural Sciences 16(3): 487-488.

A study was conducted in Karnataka to investigate the effect of different plantations including teak on soil physical properties such as particle size distribution, texture and bulk density. Results showed that clay fraction was highest in soils under teak. Soil texture was changed form loamy sand to sandy loam under all plantations. Bulk density was the highest under teak.

0334 Rathod, R; Devar, K.V. 2003. **Studies on the exchangeable nutrients of soil under different plantations**. Karnataka Journal of Agricultural Sciences 16(3): 489-490.

The nutrient contents of soils under all plantations and their respective control sites were determined. Results showed that among the exchangeable cations studied, the Ca and Mg contents were higher in soils of all the plantations and control sites. Calcium content was found highest in teak.

0335 Rathod, R; Devar, K.V. 2004. **Available nutrient status of soil under different plant communities**. Karnataka Journal of Agricultural Sciences 17(1): 132-133.

A study was conducted to know the nutrient status of different plantations which include *Tectona grandis* in Karnataka, India. A depletion of nitrogen is reported in soils under teak.

0336 Raweesri, S. 1961. **Correlation between teak growth and depth of A-horizon in Mae Huad teak plantation (1944) Ngao, Lampang**. (Thai). Student Thesis. Kasetsart University, Bangkok.

A highly significant correlation was observed between depth of A-horizon and rate of growth of plantation teak.

0337 Reuysungneun, S. 1961. **Correlation between the depth of A-horizon and teak growth in Mae Huad teak plantation**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The depth of A-horizon is correlated to teak girth significantly.

0338 Rouysungnern, S. 1982. **Some soil physical and chemical changes under tree plantation at Dong-lan reforestation area**. 18p.

Soil properties from up to 20-yr-old plantations were investigated. Soil samples from plots planted with species including *Tectona grandis* were compared with samples from a contiguous unplanted plot. Infiltration and porosity were greatest in the unplanted plot, while in the plantations, soil is compacted and removed the herbaceous layer so the roots were from tree species only.

0339 Sabharwal, L.R. 1938. **Effect of burning of slash on soil and succeeding vegetation**. Indian Forester 63(2): 81-82.

A general paper comparing German experience of adverse effects of mixing ash with that of India and concludes for teak regeneration and dry forest regeneration (Rab method) burning is highly beneficial and essential.

0340 Sachan, R.S; Sharma, R.B; Chibber, R.K. 1980. **Nature and status of organic matter of some forest soils of India as influenced by the heterogeneity of plant cover and climatic conditions**. Indian Journal of Forestry 3(4): 315-319.

Four forest types including teak were studied from different climatic regions of northern India covering 556-1731 m altitude and 93-156 cm annual rainfall. Morphological descriptions of the soil profiles under each are given. The organic carbon content and the quantities and proportions of humic acid, fulvic acid and nonhydrolyzable humins were found influenced by vegetation cover.

0341 Sahu, S; Gupta, S.K. 1988. **Forms of potassium in some soils under forest cover**. Indian Agriculturist 32(1): 23-29.

The results are presented of analyses of four soil profiles from West Bengal under different forest covers including *Tectona grandis*.

0342 Sahunalu, P. 1970. **The estimation of site quality of mixed deciduous forest with teak, Mae-Huad, Lampang as determined by organic matter and nitrogen content of soil**. Proceedings of the 3rd National Forestry Conference, Royal Forest Department, Bangkok: 17p [Forest Research Bulletin 11, 1970: 18p. Kasetsart University, Bangkok].

The study carried out to estimate site quality wherein sampling of soil was done and total height and diameter were measured. A correlation between tree biomass and site quality as represented by N content was observed.

0343 Salifu, K.F; Meyer, W.L. 1998. **Physico chemical properties of soils associated with logged forest and areas converted to teak (*Tectona grandis* Linn.f.). in Ghana**. Commonwealth Forestry Review 77(2): 91-99, 157, 159-160.

Physico chemical properties of soil under two forest covers, logged forest and teak plantation, at 3 locations in the high forest zone of Ghana were compared using one-way analyses of variance (ANOVA). In B-horizons, higher calcium in soils under teak plantations was attributed to the active role of teak in pedogenesis.

0344 Salifu, K.F; Meyer, W.L; Murchison, H.G. 1999. **Estimating soil bulk density from organic matter content, pH, silt and clay**. Journal of Tropical Forestry 15(2): 112-120.

Models for predicting bulk density as a function of easily estimated soil physico-chemical properties were explored for soils under teak plantations. Using data from about 28 soil pedons from Bosomoa, Tain II and Yaya forest reserves in the High Forest Zone of Ghana, multiple regression relationships were developed to predict bulk density.

0345 Salifu, K.F; Meyer, W.L; Murchison, H.G. 2002. **Bulk densities of Ghanaian forest soils in relation to other physico-chemical soil parameters**. Journal of Tropical Forest Science 14(1): 49-60.

Prediction of soil bulk density requires taking several representative volumetric soil samples which is often laborious and difficult, particularly for wet and stony mineral soils. Alternative empirical models to predict bulk density under teak plantations from physico-chemical soil properties are presented.

0346 Sangknenw, N. 1968. **Variation of some plant nutrients in various depths of soil in 0, 2, 4, 6, and 8 years old teak plantations at Mae Huad, Lampang**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The plant nutrients after study of soil pH, organic matter phosphorus and potassium are considered not adequate in different ages, of teak plantations and these soils require fertilization for improvement.

0347 Sankar, S. 1989. **Soils as influenced by slash burning for raising plantations of teak**. Van Vigyan 27(1): 6-11.

Various slash burning and taungya treatments were tested for their effects on soil properties in plots in a finally felled 1926 teak plantation in Nilambur Forest Division, Kerala, which was replanted in 1982. There were 6 treatments: full slash burning, reduced slash burning and no slash burning, all with and without taungya. Measurements are made of pH, exchangeable bases and organic matter.

0348 Sarlin, P. 1963. **The application of forest pedology to afforestation**. (French). Bois et Forests des Tropiques 90: 17-31.

Discusses the causes of unequal success of teak plantations at different positions on a soil catena. It is possible to determine the suitability for teak of a soil in a homogeneous climatic zone by the content of exchangeable bases in the upper horizons and effective rooting depth. Possible use of aerial photos is discussed. Some account is given of studies in progress at the Centre Technique Forestier Tropicale to distinguish the effects of soil and of competition on young plantations.

0349 Sarlin, P. **Soils and teak: Preliminary findings from the study of soils in teak plantations in certain countries of Tropical Africa with special reference to Togo**. FAO Asia Pacific Forestry Commission, Bangkok: 25p.

Includes a note on the use of the 'L.A.P.' luxmeter for measuring relative light intensity.

0350 Seth, S.K; Kaul, O.N; Gupta, A.C. 1963. **Some observations on nutrition cycle and return of nutrients in plantations at New Forest**. Indian Forester 89(2): 90-98.

A preliminary investigation was made, and results are tabulated, of the return of organic matter, leaflitter constituents, return of inorganic nutrients, mineral constituents of green leaf, bark and wood, and estimated total nutrients in standing trees including *Tectona grandis* at Dehra Dun.

0351 Seth, S.K; Yadav, J.S.P. 1958. **Teak soils**. Proceedings of the All India Teak Study Tour and Symposium: 121-137. Forest Research Institute, Dehra Dun.

0352 Shanmuganathan, K. 1997. **Teak plantations and environment**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 259-261. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Tremendous biotic pressure on teak plantations, including cattle grazing, has led to reduced undergrowth, increased run-off, and compaction and erosion of soil. Raising teak on the same sites after each rotation has also contributed to the deterioration of soil fertility. Growing appropriate undercrops after third and fourth thinning and soil fertilization will be useful for retaining the soil moisture and increasing the soil nutrient status. Growing teak plantations following a technical-short rotation, instead of conventional rotation of the maximum volume production, to maintain a sustained yield without any hinderence to the environment is proposed.

0353 Sharma, S.K; Singhal, R.M; Samra, J.S; Banerjee, S.P; Singh, K; Sharma, S.D. 1988. **Study of some difficult sites of Siwalik Forest Division with respect to their management**. Van Vigyan 26(1/2): 15-18.

A study was made of the soil characteristics and vegetation on three sites in the Pathri block of the Siwalik Forest Division, Uttar Pradesh. The soils of the area are of two types, aquic hapludoll and typic haplaquoll. Data are given on the growth of plantations of *Tectona grandis* and *Eucalyptus tereticornis* and a mixed plantation. *T. grandis* display severe mortality.

0354 Singh, A.K; Prasad, A; Khatri, P.K; Singh, B. 1987. **Physico chemical properties of soils developed over gneissic rocks under different forest covers in Nagri Range of South Raipur (Madhya Pradesh)**. Journal of Tropical Forestry 3(1): 37-47.

Analysis of soil samples collected from slopes of 1-3 under a teak plantation with *Terminalia belerica* and *Salmalia malabaricum* and other plantations is made and the results are presented.

0355 Singh, A.K; Totey, N.G. 1985. **Physico chemical properties of bhata soils of Raipur (M.P.) as affected by plantation of different tree species**. Journal of Tropical Forestry 1(1): 61-69.

Soil profiles were examined in plantations of teak, mixed species including *Tectona grandis* as well as on bare ground with ephemeral vegetation but no trees. Physical and chemical properties are tabulated. Soil pH was reduced under the plantations. Higher concentration of organic matter were found under the mixed stand, followed by teak and *P. emblica*.

0356 Singh, A.N; Raghubanshi, A.S; Singh, J.S. 2004. **Impact of native tree plantations on mine spoil in a dry tropical environment**. Forest Ecology and Management 187(1): 49-60.

This study describes the impact of young high density plantations of two native leguminous and one non-leguminous timber tree of *Tectona grandis* species on the soil redevelopment process during the early phase of mine restoration in Madhya Pradesh.

0357 Singh, D; Srivas, N.C; Mannikar, N.D. 1983. **Soil characteristics as influenced by closure of forests of Bundelkhand division and the native vegetation associated with it**. Indian Forester 109(2): 101-110.

Bundelkhand forests are of the tropical dry deciduous type and dominated by teak. They provide fuel, timber and grazing and are managed by coppice with standards. Surface soil samples were collected and analysed for organic C, available P and K, total N, exchangeable Ca and pH. Physical characteristics of the soil were also recorded. Most of the soils were slightly acidic and rich in organic C and available N, P and K. Soil fertility increased with time of forest closure as shown by increased availability of organic C, P and K. Teak was found on acid to neutral soils with a high C: N ratio.

0358 Singh, E.N; Nungchim, A; Singh, S.S; Tiwari, S.C. 2001. **Influence of *Tectona grandis* and Duabanga grandiflora on soil properties in humid tropics of Arunachal Pradesh**. Indian Journal of Forestry 24(2): 135-142.

A study was conducted in Arunachal Pradesh to quantify the amount of litterfall and nutrients returned of teak and kokhon plantations and to evaluate their effect on the physical, biochemical and microbiological properties of the soils in the area. Results showed that there was a general improvement of soil properties.

0359 Singh, J; Gupta, G.N; Prasad, K.G. 1988. **Soil vegetation relationship studies in some selected tree species of Mudumalai Forest Division**. Indian Forester 114(7): 390-398.

The studies were made in the Mudumalai Wildlife Sanctuary on the southern slopes of the Nilgiris in Tamil Nadu. Data were collected on the density and girth of 3 species which include *Tectona grandis* during a soil and vegetation survey of the Division. A total of 53 quadrats at an interval of 1-2 km were analysed; a soil profile was exposed in each and physical and chemical characteristics of the soil horizons are determined. Density and growth of *Tectona grandis* were high on medium textured soils. *Tectona gran-*

dis grew well on soil rich in Ca, Mg, organic carbon and with a higher CEC.

0360 Singh, J; Prasad, K.G; Gupta, G.N. 1986. **Distribution of teak under different silvo-climatic conditions in some parts of the Western Ghats**. Indian Forester 112(11): 1008-1015.

Soil samples were analysed and teak density recorded on sample plots in the Mudumalai Wildlife Sanctuary and in the Coimbatore Forest Division, Tamil Nadu. Results indicated that teak density was higher on medium textured soils on gentle slopes of moderate temperature. Sites with high very high teak density tended to have higher organic C, exchangeable Ca and CEC in the upper soil layers.

0361 Singh, K.P. 1979. **Nutrient and carbon storage in soils of deciduous forests in India**. Geo Eco Tropical 3(1): 35-52.

Soil profiles were taken from five forest stands in the Varanasi Forest Division, Uttar Pradesh, dominated by species including *Tectona grandis*. In all stands, organic C, total N, CEC, exchangeable Ca, Mg, and K and available P were greatest in the soil surface layer, decreasing rapidly with depth.

0362 Singh, K.P; Srivastava, S.K. 1985. **Seasonal variations in the spatial distribution of root tips in teak (*Tectona grandis* Linn.f.) plantations in the Varasani Forest Division, India.** Plant and Soil 84(1): 93-104.

In 19 and 29 yr old plantations on 'red' and 'alluvial' soils, respectively, the seasonal pattern was similar although the alluvial site had a greater number of root tips. Root tip density showed a mid rainy season peak followed by a steady decline after the winter rains. Root tip density decreased with increasing distance from the tree base and with depth in the soil. Soil moisture and rainfall were significantly positively correlated with root tip density.

0363 Singh, K; Banerjee, S.P. 1980. **State of soil aggregation under plantation forests and agriculture in alluvial soil of Doon Valley**. Van Vigyan 18(3/4): 31-38.

Macro-aggregates were preponderant in the surface layers under plantations of *Tectona grandis* of 51.1 percent. Smaller aggregates were present in higher proportions at lower depths.

0364 Singh, P; Das, P.K; Nath, S; Banerjee, S.K. 1990. **Characteristics of teak (*Tectona grandis*) growing soils in the tarai region of West Bengal**. Van Vigyan 28(1/2): 6-15.

A report is given of soil chemical characteristics and clay content for 22 sites with plantations 5-47 yr old. Soils were acidic and contained appreciable amounts of organic C, total N and exchangeable Ca. Height was significantly correlated with total N, cation exchange capacity, exchangeable Ca, and CaO and MgO of surface soil.

0365 Singh, R.B; Mishra, T.K; Banerjee, S.K. 1994. Spatial variability of soil attributes under different community structure of *Tectona grandis* stands in basaltic region. Indian Journal of Tropical Biodiversity 2: 433-440.

0366 Singh, R.B; Prasad, H; Argal, A. 2003. **Spatial variability of soil properties and phytosociological study under different ages of *Tectona grandis* stands in and around Balaghat (M.P.).** Indian Forester 129(12): 1479-1487.

The spatial variability of soil properties and phytosociological study under different age series of plantations of *T. grandis* at Balaghat (Madhya Pradesh) was studied. The effect of trees on soil pH and organic carbon is prominent under older plantations. Sites of older plantations exhibited better soil properties. Species diversity was directly related with soil heterogeneity.

0367 Singh, R; Singh, R.K; Singh, K. 1990. **Effect of different plant covers on soil characteristics**. Indian Forester 116(10): 795-802.

Data are presented and discussed from analyses carried out on samples collected in the Doon valley in northern Uttar Pradesh, from under 6 forest plantations including teak and one agricultural site. The soil at all sites was deep alluvial with a very deep water table. Organic C, total N, available K, exchangeable Mg and cation exchange capacity were also studied. Exchangeable Ca under *T. grandis* was found the highest.

0368 Singh, S.B; Chaubey, A.K; Prasad, K.G; Banerjee, S.P. 1987. **Separation of four ecosystem soils of lateritic belt**. Journal of Tropical Forestry 3(4): 344-348.

Four forest ecosystems of sal coppice forest, sal coppice forest dominated by teak, a teak plantation and a mixed plantation in the lateritic belt of West Bengal were selected for studying soil properties. Mean values of, and relationships between six soil chemistry variables of organic carbon, humus carbon, humic acid, fulvic acid, exchangeable calcium and magnesium were used to distinguish soils of each site on an individual basis. The results of the humic acid analyses and the relationships between humic acid and fulvic acid, humid acid and organic carbon, and fulvic acid and Mg separated the four sites into three groups. It is suggested that multivariate rather than univariate analysis is generally a better method of distinguishing between soils under different vegetation types.

0369 Singh, S.B; Nath, S; Pal, D.K; Banerjee, S.K. 1985. **Changes in soil properties under different plantations of the Darjeeling Forest Division**. Indian Forester 111(2): 90-98.

A study of soil property changes under plantations including *Tectona grandis* and mixed species is made. The pH, organic carbon, CEC, total K_2O and P_2O_5 and clay content of soil in different horizons in each plantation are tabulated, and estimates are also given of exchangeable Ca, Mg, Na and K. The beneficial action of *T. grandis* in recycling Ca is noted.

0370 Singh, S.B; Prasad, K.G; Banerjee, S.P. 1988. **Chemical attributes in soils under different vegetation in semi-arid region**. Van Vigyan 26(3/4): 96-97.

Surface soil samples were taken from adjoining sites of paddy, grape vine, sal, teak and chir pine in Purulia Forest Division, West Bengal. All sites had similar soil parent materials, ground cover and topography. Analyses were made of soil separates, pH, organic carbon, exchangeable cations and available P and K. Available K was highest under teak and sal. CEC at the different sites was closely related to organic carbon and clay contents.

0371 Singh, S.B; Prasad, K.G; Banerjee, S.P. 1988. **Distribution of nutrients in lateritic soils with special reference to vegetation**. Van Vigyan 26(1/2): 24-29.

Lateritic soils from three plantations of species including teak and mixed sal, teak and eucalypts and two natural forests in West Bengal were compared for their physico-chemical properties. The results were interpreted in terms of correlations between soil depth and soil characters. Organic matter was highest in the teak plantation. Exchangeable Ca was also highest under the teak plantation

0372 Singh, T.P. 2003. **Potential of farm forestry in carbon sequestration**. Indian Forester 129(7): 839-843.

Presents a case study in Pilibhit District, Uttar Pradesh on the potential of farm forestry to sequester CO2 and found that trees including teak holds tremendous potential for sequestering and storing carbon.

0373 Somsophon, U. 1961. **Correlation between the depth of soil and the height of teak in Mae Huad teak plantation**. (Thai). Student Thesis. Kasetsart University, Bangkok.

From the data collected a significant correlation was obtained between depth of soil and growth of teak.

0374 Soni, P; Naithani, S; Mathur, H.N. 1985. **Infiltration studies under different vegetation cover**. Indian Journal of Forestry 8(3): 170-173.

Infiltration rates were measured in Uttar Pradesh under plantations of *Pinus roxburghii* (burned and unburned), teak, sal, Eucalyptus, bamboos and in ungrazed but cut grassland. Soil texture, bulk density, percent pore space, soil moisture content and clay, silt and sand content were also recorded.

0375 Srisuksai, B. 1992. **Nutrient losses from teak stump harvesting**. Proceedings of the Seminar on 50 Anniversary of Hyay-Tak Teak plantation, Bangkok, 5-8 August 1992.

Study was conducted to observe soil nutrient losses after harvesting of teak seedlings for stump preparation. The nutrient analysis showed that the total amount of N, P, K, Ca and Mg content in a teak seedling were 3.56, 0.48, 5.38, 1.84 and 0.85 percent of total dry weight, respectively. Conversely, the total amount of N, P, K, Ca and Mg losses from the nursery centre were 16.38, 1.92, 16.96, 6.91 and 3.01 kg/rai (6.25 rai=1 ha).

0376 Srivastava, M.M; Negi, J.D.S; Raizada, A. 1988. **Nutrient accumulation patterns in some man-made forest ecosystems in India**. Advances in Forestry Research in India 2: 221-229.

A compilation of data from various authors on concentrations of major elements (N, P, K, Ca, Mg) in standing plantations of several important species including teak in India, giving values for the constituent above-ground and (in some cases) below-ground parts.

0377 Srivastava, R; Gaikwad, S.T; Ram, J. 1991. **Characteristics and classification of some forest soils of Chandrapur District of Maharashtra**. Van Vigyan 29(4): 234-238.

Eight soil types are described from this area which is dominated by teak and other species.

0378 Sutapak, S. 1968. **Some chemical properties of soil in 0-8 years old Mae Huad teak plantation, Lampang**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Quantity of soil organisms are observed to be more in A-horizon. Soils from teak plantations of 2 and 4 years have more soil organisms than 0, 6 or 8 years old. But no such differences were observed in B-horizon of the soil. The phosphorus in 4 year old is greater than 0, 2, 6 and 8 years and K in 0-4 years is greater than 2, 4 or 8 years plantations. The pH in A-horizon of 4 years old is more than 0, 6 years and no difference to 2 and 8 years.

0379 Suwannapinunt, W; Thaiutsa, B; Kaitpraneet, W. 1975. **Relation between the total soil nitrogen content and the soil organic matter content in Mae Huad Teak plantation, Ngao, Lampang**. (Thai). Faculty of Forestry, Kasetsart University, Thailand, Research Note 13: 13p.

0380 Tang, H.T; Abd Kadir, J. 1979. **An assessment of the teak (*Tectona grandis*) plantations at Mata Ayer Forest Reserve, Perlis**. Malaysian Forester 42(2): 83-95.

Stands on alluvial or alluvial-type wet yellow soils showed a maximum of d.b.h. m.a.i. of 0.58 inches and were superior in all respects to those on lateritic soils. There seems to be potential for expanding the area of teak plantations on alluvial and alluvial-type soils.

0381 Thaiutsa, B. 1968. **The relation between soil and teak**. (Thai). Proceedings of the First Silvicultural Seminar of Royal Forest Department, Ministry of Agriculture, Bangkok R 118: 32-43.

0382 Thaiutsa, B; Khemnark, C; Suwannapinunt, W; Kaitpraneet, W; Chaicharus, S. 1975. **Soil properties of teak plantation after thinning**. (Thai). Faculty of Forestry, Kasetsart University, Thailand, Forest Research Bulletin 37: 27p.

Thinnings were made in an 8-year-old *Tectona grandis* plantation in Lampang at four intensities based on original basal area. The effects on tree growth and soil properties were evaluated after five years. Results showed that the physical and chemical properties of the soil were not significantly different under the different thinning intensities, except for organic matter, which decreased with increased thinning.

0383 Thaiutsa, B; Suwannapinunt, W; Kaitpraneet, W; Sukwong, S. 1976. **Changes of soil properties in teak forest under the different silvicultural systems**. Forest Research Bulletin, Faculty of Forestry, Kasetsart University, Thailand 39: 33p.

Physical and chemical analyses of soils from three silvicultural systems (clear felling, strip felling and selection felling) in the Hae Huad teak forest, Lampang are presented. Soil stability differed significantly between systems: soils from clear-felled areas were more erodible than those from strip-felled or selection plots. Water availability, organic matter and K content increased with increased canopy removal. It is concluded that clear-felling or coppicing methods should be possible for this species, instead of the usual selection system.

0384 Thomas, T.P. 1989. **Effect of varying soil moisture and bulk density on teak, eucalypt and albizia root growth**. KFRI Research Report 58 (Summary): 7p. Kerala Forest Research Institute, Peechi.

Sandy loam surface soil from the Peechi campus of KFRI, Kerala, was used in pot experiments with seedlings of teak, *Eucalyptus tereticornis* and albizia. Soil samples in concrete pots were compacted to three bulk densities of 1.1, 1.4 and 1.6 g/cm3 which corresponded to maximum water holding capacities of 27, 16 and 14 percent respectively. Six-month-old polypot seedlings of the three species were transplanted to the pots and grown for six months. Then they were harvested and measurements of root and shoot length and biomass, and number of leaves and internodal length were taken. Root length in teak seedlings was reduced at soil densities of 1.4 and 1.6 g/cm3. Root biomass was reduced only at a soil density of 1.6 g/cm3, for all species. Shoot length of teak was not significantly affected by treatments, while shoot biomass was slightly higher at soil density 1.4 g/cm3 than at 1.1 g/cm3, but was reduced at 1.6 g/cm3.

0385 Thorenaar, A. 1928. **Fallow land in forestry**. (Dutch; English). Tectona 21: 295-315.

On easily peptisating and heavily eroded grounds it is possible to recover the fertility by using silvicultural fallow. On the soils planting in the silvicultural fallow is recommended, the structure of the first mentioned soil being damaged by taungya, when cultivated during moist weather. To the part fallow belongs, all vegetation besides the main species of trees that maintain and promote the fertility of the soils. The methods of using part fallow are discussed.

0386 Thorenaar, A. 1929. **The furtherance of partial fallow**. Tectona 22: 992-995.

0387 Totey, N.G; Bhowmik, A.K. 1990. **Sand mineralogy of soils of Mohgaon Teak forests, Mandla, Madhya Pradesh**. Journal of the Indian Society of Soil Science 38(2): 361-362.

Mineralogy of fine sand fractions were investigated and related to the growth characteristics of teak [*Tectona grandis*]. All pedons were rich in weatherable minerals like plagioclase, chlorite and hornblende, and their inherent fertility status was rated high. This was reflected by the average girth of teak at breast height.

0388 Totey, N.G; Prasad, A; Bhowmik, A.K; Khatri, P.K. 1992. **Soil productivity as related to radial growth of teak of Seoni and Raipur forests in Madhya Pradesh**. Journal of the Indian Society of Soil Science 40(3): 534-539.

Data from teak sample plots in Seoni and Raipur Forest Divisions were used to compute soil productivity indices from soil physicochemical data. The resulting indices were significantly correlated with radial growth data for teak at 35 and 55-60 yr old. Regression equations showing the relation are given for the two older ages.

0389 Totey, N.G; Singh, A.K; Bhowmik, A.K; Khatri, P.K. 1986. **Effect of forest cover on physico-chemical properties of soils developed on sand stone**. Indian Forester 112(4): 314-327.

Soil samples were collected in mixed stands and in pure plantations of teak and eucalypts in the Kotma and Ghunghuti Ranges in Madhya Pradesh. Weathering appeared to be more rapid under teak than under eucalypts. Ratios of clay to non-clay fractions, the thickness of the A horizon, the percentage organic matter, CEC, pH and exchangeable Ca and Mg were all greater under teak than under eucalypts. The concentration. of soluble salts was greater under eucalypts, followed by teak. Eucalypts performed better in the Ghunghuti Range, while teak grew better in the Kotma Range.

0390 Vahid, S.A. 1927. **An attempt to correlate the geology and forest types of North Chanda Division: Central Provinces**. Indian Forester 53(10): 576-582.

Recognising pure teak and mixed teak types, an attempt is made to correlate forest types with geology and soils of the tract. The author concludes that the best teak is found on Vindhyan sand stones and shales and to some extent on Kamthi and sand stones; good teak occurs on metamorphic rocks when capped with laterite; teak occurs in areas where geological and soil conditions are favourable.

0391 Venekanand. 1931. **Preservation of soil fertility in Indian teak plantation**. Indian Forester 57(2): 91-95; Madras Forest College Magazine September 1930.

Discusses various measures to maintain (1) site preparation and burning, (2) moisture condition of soil, (3) aeration, (4) introduction of leguminous shrubs, (5) maintenance of undergrowth, (6) early closure of canopy, (7) protection from high winds, and (8) protection of humus. The author concludes that absence of regeneration in both natural forest and plantations is due to (a) absence of suitable proportion of organic matter in soil and (b) maintenance of fine tilt over surface permitting moisture availability and movement, and advocates protection of humus from exposed canopy and fires.

0392 Verhoef, L. 1943. **Root studies in the tropics VI. Further data on the oxygen requirement of the root system**. (Dutch). Korte Meded Boschbouw Proefsta 81: 65p.

Describes work, in continuation of Coster's studies (Korte Meded. Boschbouwproefsta., Buitenzorg No. 31, 1932), on 373 species of trees, shrubs and herbs. Some correlation was found to exist between taxonomic groups (families and genera) and O2 requirement, though it is not possible on the basis of this to predict the O2 requirement of individual members of such groups. In general, results for any given species were fairly consistent. Species of the plains tended to have a higher tolerance of O2 deficiency than those of the mountains. Points worthy of special attention are: (1) Godavari Teak was much more resistant to O2 deficiency than other races of *Tectona grandis*. (2) Altingia excelsa showed wide variation in O2 requirements and is suspected on other grounds of representing several races or varieties. (3) Schima noronhae and S. bancana, sometimes regarded as conspecific, differed in their O2 requirements. (4) Species which, owing to high resistance to O2 deficiency, may be worth growing on swampy or heavy soils, are:- *Acacia arabica*, Cassia grandis, Carapa guianensis, Khaya senegalensis, Filicium decipiens, Eugenia lineata, Casuarina junghuhniana, Zizyphus celtidifolia, and to a lesser degree- *Acacia auriculiformis* , Inga laurina, Peltophorum pterocarpum, Anacardium occidentale, Zizyphus jujuba, Manilkara kauki, Mimusops elengi, Eugenia cumini, *Casuarina equisetifolia* and Anthocephalus macrophylla. (5) Of green-manure and cover species, etc., the following have a fairly high resistance against O2 deficiency:- Sesbania sesban, Indigofera galegoides, Aeschynomene americana, Leucaena pulverulenta, Acacia villosa and Thespesia lampas.

0393 Verma, R.K; Totey, N.G. 1999. Biological diversity, medicinal potential of ground flora and improvement in soil quality under plantations raised on degraded bhata land. Advances in Forestry Research in India 20: 37-69.

0394 Vimal, M; Sudhakara, K; Jayaraman, K; Sunanda, C. 2003. **Effect of soil-leaf nutritional factors on the productivity of teak (*Tectona grandis* Linn.f.) in Kerala**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

A study was conducted to identify and assess the nutritional factors limiting productivity of teak plantations of different age groups belonging to different site qualities spread throughout the state of Kerala. The nature of relation between tree growth and the soil/leaf nutrient status and current annual increment in basal area per tree and soil/leaf nutrient status in each age group were investigated. The relation between leaf nutrient status and tree volume was feeble. The models obtained through stepwise regression were all linear in nature and no quadratic terms were present. The critical nutrient concentrations with respect to tree volume do not seem to be attained by the levels of nutrients available in the present data set. It indicates that volume of trees could be increased further by adequate supply of appropriate nutrient elements. The relation between tree growth and nutrient status of soil was stronger compared to the relation between the growth and nutrient status of leaves.

0395 Wachirajutiphong, T. 1968. **The comparison of first log volume and A-horizon depth of Huay teak with Klang-Dong Teak Plantation, 1954-56**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The depth of A-horizon of Klang-dong plot is significant to that of Huay Tak and has more depth, and also the first logs have more volume.

0396 Wanner, H; Soerohaldoko, S; Santosa; Natalia, P.D; Panggabean, G; Yingchoi, P; Nguyen Thi Thuyet Hoa. 1973. **Soil respiration in different types of Southeast Asian tropical rain forest**. Oecologia 12(3): 289-302.

The vegetation varied, according to precipitation and soil type, from lowland to montane rain forest, teak forest, monsoon forest and heath forest. In all the forest types, soil respiration values were of the same order of magnitude and indicated an oxidation of organic matter of 10 - 13 t/ha/year. The difficulties connected with equating soil respiration values and net production of the different forest types are discussed.

0397 Watterston, K.G. 1971. **Growth of teak under different edaphic conditions in Lancetilla valley, Honduras**. Turrialba 21(2): 222-225.

Comparison of four plantations aged 24 and 27 years on alluvial soil indicated that the most important factors affecting the growth of teak were spacing and soil depth. Imperfect drainage on some sites did not appear to affect growth and form.

0398 Xue, L; Kuang, L.G; Chen, H.Y; Tan, S.M. 2003. **Soil nutrients, microorganisms and enzyme activities of different stands**. Acta Pedologica Sinica 40(2): 280-285.

The nutrient concentrations, microorganisms and enzyme activities of soil in *Tectona grandis* stands along with other species were studied. It is found that *Tectona grandis* stands could increase organic matter content and improve the nutrient status of soil.

0399 Yadav, J.S.P. 1968. **Physico chemical characteristics of some typical soils of Indian forests**. Indian Forester 94(1): 85-98.

Describes eleven typical soils under certain important forest types in India. Teak attains best quality on moist soils developed from basalt which is acidic and has adequate amount of exchangeable calcium and availability of phosphorous.

0400 Yadav, J.S.P. 1969. **Soil study for site suitability appraisal of forest plantations in north Bihar**. Indian Forester 95(3): 139-148.

Detailed physical and chemical analyses of soil profiles were made in 1966 in non-calcareous and highly calcareous areas. Average growth data are given for different plantations including *Tectona grandis* and apparent correlations with the soil characteristics are discussed. All the soils are alluvial sands with a relatively finer-textured top layer.

0401 Yadav, J.S.P; Chand, G; Dhar, B.L. 1971. **Mineralogical studies in some soils of North Bihar afforestation areas**. Indian Forester 97(7): 401-405.

Tabulates and discusses the results of field studies in the Champaran and Purnea districts of N. Bihar on the growth of young *Tectona grandis*, *Dalbergia sissoo* and *Dendrocalamus strictus* in relation to the distribution of light and heavy minerals in the various soil profiles. There appeared to be no direct correlation between any particular mineral or group of minerals and growth of the plantations.

0402 Yadav, J.S.P; Sharma, D.R. 1967. **A soil investigation with reference to distribution of sal and teak in Madhya Pradesh**. Proceedings of the eleventh silvicultural conference, Dehra Dun, 15-25 May 1967: 204-215. Forest Research Institute and Colleges, Dehra Dun, India.

Research in 1962 suggested that high values for exchangeable Ca2+ were important in favouring the predominance of teak over other species.

0403 Yadav, J.S.P; Sharma, D.R. 1968. **A soil investigation with reference to distribution of sal and teak in Madhya Pradesh**. Indian Forester 94(12): 897-902.

Data derived from investigations in 1962 indicate that Teak tends to occur on soils with the highest content of exchangeable Ca, *Shorea robusta* on soils with medium Ca content, and miscellaneous species on coarse shallow soils with low Ca.

0404 Zech, W. 1990. **Mineral deficiencies in forest plantations of North-Luzon, Philippines**. Tropical Ecology 31(1): 22-31.

On 3 sites in North Luzon, soil and leaf analyses were carried out to verify whether deficiency symptoms such as chlorosis, dieback of shoots, growth reduction and even breakdown of the trees, are associated with inadequate mineral nutrition. Stunted growth of teak is reported to have been influenced by nutrient deficiencies.

Go top

Litter Decomposition

(See also 0065, 0275, 0372, 0600, 4577)

0405 Asha Sinha. 1992. **Leaching of nitrogen, phosphorus, and potassium from decomposing leaf litter of teak (*Tectona grandis* Linn.f.).** Journal of Potassium Research 8(4): 338-343.

Nutrient leaching from litter leachates was estimated using a new type of apparatus. Leaching was greatest in June and decreased thereafter. Amounts of K in the leachates were greater than those of N and P.

0406 Aweto, A.O. 2001. **Impact of single species tree plantations on nutrient cycling in West Africa**. International Journal of Sustainable Development and World Ecology 8(4): 356-368.

This paper evaluates the impact of plantation monocultures of fast-growing exotic species including teak on nutrient cycling in West Africa. The rates of nutrient uptake and recycling to the soil vary with tree species and ecological zones. In general, single species tree plantations immobilize soil nutrients faster and return less nutrients to the soil than native forest and savanna vegetation. Hence, they deplete soil nutrients.

0407 Bhadoria, H.B.S; Singh, V.P. 1996. **Effect of urea and lime treatments on in vitro dry matter and cellulose digestibility of fallen teak leaves**. Indian Journal of Animal Nutrition 13(4): 220-223.

Proximate composition and tannin content of fallen teak leaves were analysed after treatment with water, water + 4 percent lime, water + 1 percent urea, or water + 4 percent lime + 1 percent urea. Treated samples were evaluated in vitro using rumen fluid. Dry matter and cellulose digestibility, and total volatile fatty acid production were higher in alkali-treated teak leaves; the mixture of lime and urea had an additive effect. There was a reduction in tannin content of the leaves after lime and lime + urea treatments.

0408 Bhadoria, H.B.S; Singh, V.P. 1996. **Physical and nutritive characteristics of fallen teak leaves (*Tectona grandis*) silage**. JNKVV Research Journal 30(1/2): 54-55.

Teak leaf silage was treated with chemicals to improve its physical and nutritive characteristics. pH varied for different silages. Highest concentration of volatile fatty acids of 1.87 percent was recorded in the treatment having urea + lime and lowest of 0.98 percent in the treatment with water. The addition of urea resulted in higher values of total volatile fatty acids.

0409 Bhadoria, H.B.S; Singh, V.P; Singh, N.P. 1996. **Physical and nutritive characteristics of fallen teak (*Tectona grandis*) leaves silage**. Indian Journal of Animal Production and Management 12(2): 117-118.

Chemical composition of fallen teak leaves was analysed after treatment with water, 4 percent lime, 1 percent urea and lime + urea. 750 days of ensiling resulted in the removal of 57.12, 85.68, 64.24 and 89.31 percent tannins. Addition of urea and lime was effective in reducing tannin content; an increase in pH, ammonia-nitrogen, total volatile fatty acids and total N of silages was also observed.

0410 Bhadoria, H.B.S; Singh, V.P. 1997. **Effect of urea and lime treatment on in vitro digestibility of dry matter and cellulose of fallen teak (*Tectona grandis*) leaves**. Indian Journal of Animal Production and Management 13(3): 162-164.

Four treatments (water (T1), water + 4 percent lime (T2), water + 1 percent urea (T3) or water + 4 percent lime + 1 percent urea (T4)) were applied to finely ground teak leaves, collected from a forest in Jabalpur during the autumn. Mean values of in vitro DM digestibility (IVDMD) differed significantly between treatments. All treatments improved IVDMD, but treatment with 4 percent lime and 1 percent urea significantly improved DM digestibility (DMD).

0411 Boquel, G; Suavin, L. 1972. **Inhibition of nitrification by aqueous extracts of litter of *Tectona grandis* and *Melaleuca leucadendron*.** Revue d'Ecologie et de Biologie du Sol 9(4): 641-654.

Aqueous extracts of tropical litter of *T. grandis* and M. leucadendron that had not previously been incubated were found to contain water-soluble compounds showing an antimicrobial influence on (a) Nitrosomonas and (b) Nitrobacter; (a) was more sensitive than (b) to these compounds, the toxicity threshold of which is lower for M. leucadendron than for *T. grandis*.

0412 Boquel, G; Suavin, L. 1974. **Solubilization of iron by two bacteria in the presence of teak litter**. Revue d'Ecologie et de Biologie du Sol 11(2): 187-195.

The solubilization of Fe from ferric oxide and ferrous sulphide in the presence of two bacteria of the genus Bacillus was studied in media containing an aqueous extract of *Tectona grandis* litter from a plantation in Senegal, with or without glucose. The results suggest that teak litter can, in the course of decomposition, initiate processes of Fe migration in tropical soils.

0413 Chaubey, O.P; Prasad, R; Mishra, G.P. 1988. **Litter production and nutrient return in teak plantations and adjoining natural forests in Madhya Pradesh**. Journal of Tropical Forestry 4(3): 242-255.

The study sites were in 20-23 yr old teak plantations and their adjoining natural forests at two sites in Madhya Pradesh. Litter production was 1.5-2.0 percent greater in the teak plantations than in adjoining forest. Showed a greater content of N, P, K and Ca in plantation than in forest litter, indicating a greater nutrient return in the plantations. The results are discussed in relation to published data on litter production in other plantations and natural forests.

0414 Egunjobi, J.K. 1974. **Litter fall and mineralization in a teak *Tectona grandis* stand.** Oikos 25(2): 222-226.

In a monoculture of teak a considerable amount of the annual litter fall fell between December and March. The mean annual litter fall (leaves, seeds plus flowers, twigs) amounted to 9024 plus or minus 882 kg ha-1, of which 90 percent was leaf litter. The nutrient content of the annual litter fall was N 90.9; P 10; K 71; Ca 188; Mg 21.6 and Na 2.1 kg/ha.

0415 Florence, L.M; Methven, I.R. 1997. **Litterfall and leaf decomposition in pure reforestation stands of introduced and indigenous species of Carranglan, Nueva Ecija Province, Philippines**. Asia Life Science 6(1/2): 16p.

Litterfall and leaf decomposition under the stands of teak was studied using the litterfall trap and litterbag techniques along with many other species. Litterfall rate was variable among basal area classes, species and time. Litterfall rate was significantly different among species with *A. auriculiformis* producing the highest litterfall rates in all size classes followed by teak. Nitrogen and the lignin contents of the leaves were found to influence the rates of decomposition.

0416 Geigel, F.B. 1977. **Organic matter and nutrients in litter of various forest trees**. (Spanish). Baracoa 7(3/4): 15-38.

Results are reported of studies at several sites in Cuba, over a 3-yr period, on *Pinus caribaea*, *Hibiscus* sp., *Swietenia macrophylla*, *Tectona grandis*, *Eucalyptus robusta* and *Casuarina equisetifolia*.

0417 George, M; Varghese, G. 1992 . **Nutrient cycling in *Tectona grandis* plantation**. Journal of Tropical Forestry 8(2): 127-133.

Biomass production and nutrient cycling were studied in a 20-year-old teak plantation in Coimbatore forest division, Tamil Nadu. The total biomass production was 180 t/ha and the annual productivity of non-photosynthetic biomass components was 8.69 t/ha. It is shown that *T. grandis* returns more nutrients than it retains and is more efficient in recycling nutrients.

0418 Girolkar, A.K; Naik, M.L. 1990. **Release of nutrients from decomposing leaf litter in artificial and natural forest sites of Raigarh Forest Division**. Comparative Physiology and Ecology 15(1): 38-44.

Measurements were made of litter decomposition and nutrient release (Ca, Mg and N) at two forest sites on hilly slopes in Raigarh Forest Division, Madhya Pradesh. The two sites were natural forest and artificial forest of a teak plantation at Lakha. The amounts of litter and nutrients accumulated after cessation of litter fall at the natural site were greater than in the plantation. Litter decomposition was also more rapid at the natural site. Generally nutrients decreased with decomposition.

0419 Hadimani, A.S; Surya Rao, P; Parvathappa, H.C; Rao, K.R. 1974. **Effects of water-soluble organic substances from different types of leaf and needle litter on the downward movement of manganese in sandy soil**. Plant and Soil 40(2): 365-372.

Describes laboratory studies on the effect of water-soluble extractives from leaves of different species including teak on the movement of Mn in sandy soil. Treatments with citric acid, glucose solution and distilled water were also included. The patterns of Mn distribution in the soil after treatment are described.

0420 Hassan, M.M; Islam, A.T.M.N. 1984. **The contribution of bamboo and some broad leaved species to the soil organic matter content**. Indian Journal of Forestry 7(3): 217-220.

Fallen leaves were collected from four bamboo species and four tree species including teak. Soil organic matter content was monitored over one year after decomposing of the leaves. A seasonal decomposition gradient was found down to 0.75 cm depth and trends were similar for all species. Maximum contributions to soil organic matter content at the stabilized amount found in May would be 31 kg/t soil for *D. indica*, 27 kg/t for *T. grandis* and about 20 kg/t for the other six species.

0421 Hosur, G.C; Dasog, G.S; Satyanarayana, T. 1997. **Litter production and nutrient return of different tree species under plantation conditions**. Indian Journal of Forestry 20(3): 231-235.

Patterns of litter production and nutrient return were studied in plantations of six tree species of 13 to 16 yr old in Dharwad, Karnataka. Litter was collected and separated into different components which were analysed for nutrient concentration, in order to estimate nutrient returns. Litterfall varied from 4099 kg ha-1 in *Tectona grandis* to 8313 kg ha-1 in *Eucalyptus tereticornis*. The contribution of leaf litter to the total litterfall was more than that of other plant parts. Plant parts showed variations in nutrient concentrations, although generally the concentrations of Ca, K and N were higher than those of other nutrients. Teak returned the lowest N, P, K and Ca. Returns of P and Mg were lower in all six species.

0422 Joshi, C.S; Rao, P.B; Singh, R.P. 1997. **Comparative study of litter fall and nutrient return in some plantations of Central Himalaya**. Proceedings of the Indian National Science Academy. Part B. Reviews and Tracts Biological Sciences 63(6): 617-624.

The pattern and the amount of litter fall and nutrient return to the soil in nine plantations of six tree species which include teak, were studied in Uttar Pradesh. The results are compared among the plantations and with published data for natural forests of the region. The leaf litter contributed a major portion of 76-98 percent of the total litter production. The regressions between species and time with abiotic factors like evaporation, rainfall, temperature and wind speed showed 30 percent variability in litter production in different plantations.

0423 Joshi, C.S; Singh, R.P; Rao, P.B. 1999. **Pattern of leaf litter decomposition in forest planta-**

tions of Tarai region in Uttar Pradesh, India. Tropical Ecology 40(1): 99-108.

Leaf litter decomposition in tree plantations include *Tectona grandis* was studied in the Tarai region of Central Himalaya to examine: (i) the rate and seasonal pattern of decomposition, and (ii) the relationship between rate, litter quality and environmental factors. The upper layer of the soil is rich in organic carbon of 2.6-6.3 percent and potassium of 347-517 kg ha-1.

0424 Jung, G. 1971. **The influence of anaerobic and aerobic incubation on the composition of water-soluble extracts of tropical litters**. Occology Plant 6(4): 297-317.

Gives the results of experiments with litter of *Acacia albida, Guiera senegalensis* and *Tectona grandis*. The water-soluble extract of *T. grandis* had high amounts of aliphatic and phenolic acids. The decomposition of water-soluble organic compounds was greater in aerobic than in anaerobic conditions. During anaerobic incubation, acidification of the water-soluble extracts took place, with the production of considerable amounts of lactic and succinic acids, resulting from anaerobic fermentation. During aerobic incubation the pH of water-soluble extracts rose rapidly, the easily-decomposing litters producing the most alkaline extracts.

0425 Kenjale, R.Y; Chavan, K.N; Chavan, A.S. 1994. **Recycling of nutrient elements by some forest tree species of Konkan in Maharashtra. II Leaf litter decomposition and release of nutrients in lateritic soil of Konkan**. Van Vigyan 32(1/2): 7-14.

The decomposition and release of nutrients into the soil from leaf litter of seven forest tree species was studied in the laboratory. The study showed that available N, P_2O_5, K_2O and exchangeable Ca and Mg were significantly higher in soil mixed with leaf litter than in barren soil. There were differences between species with respect to release of the different nutrients studied.

0426 Kotwal, P.C; Mall, L.P. 1977. **Litter production and disappearance in tropical dry deciduous forests near Ujjain, M.P**. Annals of Arid Zone 16(1): 111-116.

Quantitative studies were carried out on litter production by seventeen important tree species which include teak of a tropical dry deciduous forest stand in Madhya Pradesh. The amount of litter contributed by each species manifested their dominance in the stand, and the total amount indicated the stocking density. The litter fall showed autumnal peak and except for some non-leaf litter, almost completely disappeared by the next season of litter fall. This favours rapid nutrient recycling.

0427 Krishnakumar, A.K; Gupta, C; Sinha, R.R; Sethuraj, M.R; Potty, S.N; Eappen, T; Das, K. 1991. **Ecological impact of rubber (*Hevea brasiliensis*) plantations in north east India: 2. Soil properties and biomass recycling**. Indian Journal of Rubber Research 4(2): 134-141.

The influence of rubber and teak plantations and natural forest on soil properties, nutrient enrichment, understorey vegetation and biomass recycling was studied at three sites in the Siliguri subdivision, Darjeeling district of West Bengal. All three sites had high input of organic carbon enriching the soil. Teak had the highest organic matter content in the surface layers. The depletion of organic carbon with depth was highest for teak and least for natural forest. The results suggest that the depletion of sub-surface soil moisture would be less under rubber than teak. The soils under teak showed a higher calcium content in the surface layers.

0428 Kumar, B.M; Deepu, J.K. 1992. **Litter production and decomposition dynamics in moist deciduous forests of the Western Ghats in Peninsular India**. Forest Ecology and Management 50(3/4): 181-201.

A field study was conducted in the moist deciduous forests of Thrissur Forest Division, Kerala, to test three hypotheses: (1) litter production in tropical forests is a function of floristic composition, density, basal area and disturbance intensity; (2) decay rate constants of tropical species are an inverse function of initial lignin/nitrogen ratio; and (3) decomposition rates in tropical forests are faster than those of temperate forests. Leaf litter decay rates for six dominant tree species including *Tectona grandis* were assessed. In general, less disturbed sites and species adapted to higher nitrogen availabilities exhibited relatively higher decay rate coefficients. *Tectona grandis*, *D. pentagyna* and *Terminalia paniculata* exhibited slower rates of decomposition. Mean concentrations of N, P and K in litter were very variable amongst the dominant species.

0429 Maity, S.K; Joy, V.C. 1999. **Impact of antinutritional chemical compounds of leaf litter on detritivore soil arthropod fauna**. Journal of Ecobiology 11(3): 193-202.

The rate of colonization and succession of soil microarthropod groups were compared with respect to antinutritional chemical parameters in the leaf litter of twelve different tree species under controlled field conditions. The initial colonization was high in *Tectona grandis*, *Casuarina equisetifolia*, *Anthocephalus chinensis*, *Cassia siamea* and *Acacia auriculiformis* . Regarding the impact of antinutritional factors, the initial colonization was high in leaf litter with less initial amounts of polyphenols and tannins. Similarly, leaf litter with minimum initial amount of lipids and lignins showed a gradual increase in the colonization rate of microarthropods. The colonization of microarthropods demonstrated their significance in trapping energy and nutrients from fast decomposing litter and suitability of some litter types in enhancing biological activity in soil.

0430 Mary, M.V; Sankaran, K.V. 1991. ***Ex-situ* decomposition of leaf litters of *Tectona grandis*, *Eucalyptus tereticornis* and *Albizia falcataria***. KFRI Research Report 71: 41p. Kerala Forest Research Institute, Peechi.

From plantations in Kerala.

0431 Naik, M.L; Shrivastava, B.K. 1985. **Leaf litter fall in the forests of Surguja (Madhya Pradesh)**. Journal of Tropical Forestry 1(2): 140-144.

Litter was collected and base area, stand age and density were recorded in teak plantations and in natural sal stands. Litter measured was higher in the plantations than in the sal stands. A similar difference was also found between litter per unit base area in the two kinds of stands. Leaf litter was positively correlated and showed a parabolic relation with base area.

0432 Nisharaj, S; Paulsamy, S; Sekaran, S. 2003. **Litterfall and nutrient return in four tropical deciduous forests of Western Ghats**. Myforest 39(1): 25-30.

Litterfall and nutrient return were studied in four deciduous forests including *Tectona grandis* plantation of Kerala. Total litterfall was the lowest in Tectona of 4492 kg/ha when compared to *Bambusa bambos*, *Dalbergia latifolia* and *Terminalia paniculata*. The return of nitrogen and potassium was least in the *Tectona* forests.

0433 Panda, A; Swain, S.L. 2002. **Leaf litter decomposition of teak, acacia and eucalyptus in plantation forest of Orissa**. Journal of Ecobiology 14(3): 223-231.

Decomposition of leaf litter of *Tectona grandis*, *Acacia auriculiformis* and *Eucalyptus hybrid* in Orissa was studied using litter bag technique. The decay rate of teak litter was higher than that of Acacia and Eucalyptus. Decomposition constant was observed to be maximum in teak litter of 1.15 and minimum in Eucalyptus litter of 0.47. The release of carbon from teak litter was 39 g percent.

0434 Pande, P.K. 1999. **Litter decomposition in tropical plantations: Impact of climate and substrate quality**. Indian Forester 125(6): 599-608.

Using the litter bag method, the decomposition rate was studied of the litter of four plantation species, which include teak in relation to their chemical composition and climatic factors. Leaf litter decomposition constants followed the order : sal 1.67 teak 1.65 pine 1.35 eucalypts 1.34. Invariably, rainfall, number of rainy days, soil moisture and temperature showed positive correlations with decomposition rate. Multiple correlation analysis showed that the cumulative effect of rainfall and temperature was also positively significant. As far as chemical constituents of litter were concerned, N and Mg contents were positively related to decomposition rate while lignin and holocellulose contents and the lignin/nitrogen ratio showed a negative correlation.

0435 Pande, P.K. 2004. **Nutrient cycling in disturbed tropical dry deciduous teak forest of Satpura Plateau, Madhya Pradesh, India**. Journal of Tropical Forest Science 16(1): 94-105.

Distribution of different nutrients in different life forms, their allocation in different tree components and nutrient cycling in teak forests of Satpura Plateau are described.

0436 Pande, P.K; Meshram, P.B; Banerjee, S.K. 2002. **Litter production and nutrient return in tropical dry deciduous teak forests of Satpura plateau in central India**. Tropical Ecology 43(2): 337-344.

The study deals with quantification of litter production, seasonal variations in litter nutrient concentration and nutrient return to the forest floor as influenced by insect defoliation and past disturbances in some tropical dry deciduous teak forests of Satpura plateau in Chhindwara forest division in Madhya Pradesh.

0437 Pande, P.K; Sharma, S.C. 1986. **Seasonality and pattern in leaf-fall and litter accretion on the forest floor in plantations of Dem-**

onstration Area, Forest Research Institute & Colleges, Dehra Dun. Indian Forester 112(4): 328-341.

Litter samples were collected from plantations of *Tectona grandis* along with plantations of many other species. Leaf fall over the year was 5009.44 for *T. grandis*. Maximum leaf fall was in April-May for teak.

0438 Pande, P.K; Sharma, S.C. 1988. **Litter nutrient dynamics of some plantations at New Forest, Dehra Dun**. Journal of Tropical Forestry 4(4): 339-349.

Measurements were made of nutrient return, release and accumulation in plantations of sal, teak, and pine and eucalypts. In general nutrient release followed the order Ca N K Mg P for teak and sal. Leaf litter contributed the most nutrient return, release and accumulation. Nutrient return followed the pattern of litter fall, whereas release depended on nutrient return and litter decomposition rate.

0439 Pande, P.K; Sharma, S.C. 1993. **Biochemical cycling and nutrient conservation strategy in some plantations**. Indian Forester 119(4): 299-305.

Monthly measurements of litterfall were made in permanent litter plots set up in four plantations in the demonstration area of New Forest, Dehra Dun, Uttar Pradesh. The plantations were of sal, teak, pine and eucalypts. Data are tabulated on the monthly and annual conservation of the major nutrients of N, P, K, Ca, Mg present and on annual nutrient return. In general, teak and sal conserved more nutrients than pine and eucalypts and conservation of N and P was greater than that of other nutrients.

0440 Pande, P.K; Sharma, S.C. 1993. **Litter decomposition in some plantations**. Annals of Forestry 1(1): 90-101.

Litter decomposition of four tree species including teak was studied in plantations using the litter bag method. Litter dry weight loss was determined monthly. Data are presented on the characteristics of the plantations such as average diameter at breast height, trees/ha, annual litterfall, and annual biomass production and the litter decomposition data analysed. Values for litter decomposition constants, and times required for loss of 50 and 95 percent litter dry weight are tabulated. Leaf litter decomposition followed the order sal teak pine eucalypts while for twig litter decomposition, the order was teak sal pine eucalypts.

0441 Pandit, B.R; Prasannakumar, P.G; Jana, C.K. 1998. **Seasonal variations in total nitrogen percentage in two different forest ecosystems in Gujarat**. Advances in Plant Sciences 11(1): 165-169.

Data are presented on the seasonal variation of nitrogen in the soil and litter of three tree species of *Tectona grandis*, *Dalbergia latifolia* and *Terminalia tomentosa*. Soil N contents varied with season and depth. The percentage of N in litter showed an increasing trend from summer to winter.

0442 Pandit, B.R; Rao, K.V.R; Subrahmanyam, S.V.S. 1992. **Litter production and chemical properties of soil in two ranges of Western Gir forest, Gujarat**. Indian Botanical Reporter 10(1/2): 28-33.

In forests dominated by teak.

0443 Pandit, B.R; Subrahmanyam, S.V.S; Rao, K.V.R. 1993. **Leaf litter production of the dry deciduous forest ecosystem of eastern Gir (Gujarat)**. Indian Forester 119(5): 375-380.

Monthly data on leaf litter production of major forest species including teak were collected using litter traps at five sites in the Gir forest. Data on floristic composition are given for all sites. Litterfall was the greatest in February and at the teak site. Litter production was generally proportional to tree density.

0444 Pradhan, I.P. 1973. **Preliminary study of rainfall interception through leaf litter**. Indian Forester 99(7): 440-445.

Leaf litter of *Tectona grandis* (a), *Dendrocalamus strictus* (b), *Albizia lebbek* (c), *Dalbergia sissoo* (d) and *Acacia arabica* (e) was placed on wire-mesh trays in the open at the Soil Conservation Research Farm, Vasad. Subsequent measurements showed that interception was greater in teak and declined in the order (e) (d) (b) (c). During the rainy season, litter decomposition was greatest for teak and least for acacia.

0445 Prasad, R; Mishra, G.P. 1985. **Litter productivity of dry deciduous teak forest stands of Sagar (Madhya Pradesh)**. Indian Forester 111(6): 359-367.

Litter sampled from these forests from 15th April to 15th May has been taken as the total annual litter production, considering locality factors and the species. Total annual litter production was found to be 4.959 t/ha of which teak contributed 37 percent, *Terminalia tomentosa* 8 percent, *Diospyros melanoxylon* 4 percent, *Butea monosperma* 6 percent and Miliusa tomentosa 3 percent.

0446 Rangarajan, T.N; Paulsamy, S; Arumugasamy, K; Murugan, A; Sekaran, S. 1997. **Litter dynamics and efficacy of certain variables on the rate of decomposition in a 40-year old teak forest, Western Ghats**. Van Vigyan 35(1): 5-13.

Litter fall and decomposition were investigated in a 40-year-old teak forest in Tamil Nadu. Total litter production was 10 321 kg/ha over the year and varied from 12.2 to 238.9 g/m2. Leaves contributed 69.79 percent, twigs 13.33 percent, bark 2.84 percent and other parts 13.98 percent. Of the soil and litter variables analysed (soil pH; soil and litter moisture; litter C:N ratio, lignin, water soluble compounds, bacteria, actinomycetes and all fungal species) significant positive relationships were found between decomposition and soil and litter moisture, litter C:N ratio and litter actinomycetes. The total number of fungal species was negatively related to decomposition.

0447 Rao, B.K.S; Dabral, B.G; Pande, S.K. 1972. **Litter production in forest plantations of chir (*Pinus roxburghii*), teak (*Tectona grandis*) and sal (*Shorea robusta*) at New Forest, Dehra Dun.** Tropical Ecology: Proceedings of the Symposium, New Delhi, January 1971: 235-243.

On the basis of 100 trees, the annual litter accumulation was 1396 kg/ha under chir, 1167 kg/ha under teak and 743 kg/ha under sal. Stand density and age were found to be the major factors determining litter production, while precipitation and wind significantly affected litter fall.

0448 Rao, K.V. 1997. **Decomposition of teak leaf by some fungi**. Journal of Mycology and Plant Pathology 27(1): 51-54.

The role of Acremonium terricola, Chaetomium globosum, Fusarium scirpi, Gliocladium sp., Gleomastrix murorum, Myrothecium roridum, Phoma sp., Pithomyces maydicus, Scolecobasidium constrictum and Syncephalastrum racemosum in the decomposition of leaf discs of teak was studied. G. murorum, Phoma sp., P. maydicus and S. racemosum were the most efficient decomposers of teak leaf discs. There was a positive correlation between the activity of different hydrolytic enzymes and the rate of decomposition.

0449 Rao, K.V. 2001. **Production of dextrinizing amylase by three teak leaf litter decomposing fungi**. Perspectives in biotechnology. Proceedings of a National Symposium, Warangal, 26-27 February 1999: 171-174. S.M. Reddy; D. Rao; Vidyavati, Eds. Scientific Publishers, Jodhpur.

Amylase production by three teak leaf litter decomposing fungi, *Gliocladium* sp., *Heterocephalum aurantiacum* and *Phoma leveillei* in different synthetic media was investigated. *Gliocladium* sp. was an efficient producer of amylase in starch supplemented medium. Amylase production increased with the increase in starch concentration. *Gliocladium* sp. and *P. leveillei* achieved maximum vegetative growth in starch medium. *H. aurantiacum* preferred starch supplemented with $CaCl_2$ medium.

0450 Rathod, R; Devar, K.V. 2003. **Pattern of litter fall and contribution by various litter components to the total litter under various forest plantations**. Karnataka Journal of Agricultural Sciences 16(3): 491-493.

This study was conducted to quantify the amount of forest litter and to assess the contribution of various litter components to the total litter under various forest plantations including teak. Among the litter components, leaf litter contributed maximum in all four plantations.

0451 Rathod, R; Devar, K.V. 2004. **Litter production and nutrient return in plantations of four tree species in Karnataka State**. Karnataka Journal of Agricultural Sciences 17(1): 68-71.

Studies on litter production and nutrient return in plantations of tree species including teak growing at Terakanahalli forest, Sirsi Forest Division, Karnataka, India were carried out.

0452 Sanit Aksornkoae; Choob Khemnark; Tawee Kaewla iad. 1972. **Study on organic matter in teak plantation**. (Thai). Faculty of Forestry, Kasetsart University, Thailand, Forest Research Bulletin 23: 41p.

Tree growth, litter fall and rate of decomposition, soil properties and soil microorganisms in five teak plantations were studied. Results showed that growth differences between burned and unburned plots were not significant; litter fall was high in March and April, with maximum decomposition in April-September, differences between soil physical properties were in general insignificant, but N, P, K and Ca content and organic matter were significantly different.

0453 Sankaran, K.V. 1993. **Decomposition of leaf litter of albizia (*Paraserianthes falcataria*), eucalypt (*Eucalyptus tereticornis*) and teak (*Tectona grandis*) in Kerala, India.** Forest Ecology and Management 56(1/4): 225-242.

Ex situ decomposition of leaf litter of *P. falcataria*, *E. tereticornis* and *T. grandis* was studied under field and laboratory conditions using the litter bag technique. The amount of CO_2 evolved from the decaying litter and the associated populations of fungi, bacteria and actinomycetes were quantified. A laboratory study was also conducted to determine the amount of organic carbon added to soil during decomposition. *T. grandis* litter decomposed rapidly compared with the others.

0454 Sankaran, K.V. 1994. **Fungi associated with the decomposition of teak and Albizia leaf litter in Kerala**. Indian Forester 120(5): 446-454.

Fungi associated with the decomposition of leaf litters of *Albizia falcataria* and teak in Kerala were studied using the dilution plate method. Teak litter had Aspergillus, Penicillium, Coniella and Tritirachium sp. as the dominant early colonizers. The secondary colonizers of both the litters included several genera of fungi imperfecti and sterile forms. Members of the Mucorales and basidiomycete mycelium were predominant on highly decomposed litter. Fungi imperfecti were the dominant colonizers of the litters.

0455 Sankaran, K.V. 1997. **Decomposition of teak leaf litter**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 242-246. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

The rate of decomposition of teak litter was studied using the litter-bag method. The dry weight loss of the litter was 95.7 percent at the end of the study period. The decomposition rate was higher during the south-west monsoon than in the north-east monsoon. Loss in litter weight was positively correlated with moisture content of litter and rainfall. The time required for 95 percent weight loss of teak litter were estimated to be 18 months. It is found that the decay rate of teak leaf litter is faster than that of eucalypt and *Paraserianthes*. Litter moisture content is crucial for the decomposition under tropical warm-humid climate and the south-west monsoon provides congenial conditions for the rapid breakdown of leaf litters in Kerala.

0456 Saravanan, S; Buvaneswaran, C. 2003. **Litter dynamics in relation to stand density in teak (*Tectona grandis*) plantations**. Advances in Plant Sciences 16(1): 229-233.

A study was conducted on teak plantations in Mettupalayam, Tamil Nadu raised in five different spacings: S1- 1 x 1; S2- 2 x 1; S3- 1.5 x 1.5; S4- 2 x 1.5; and S5- 2 x 2 m, to investigate the influence of stand density on litter dynamics. It was found that the annual litter production varied significantly with density of the tree stands. The highest amount of litter was produced under the stand under S1 spacing of 530 kg/ha/year and the least amount of litter production of 260 kg/ha/year was recorded under S5. The tree stands under S1 and S2 spacing showed significantly slower rate of decomposition than the rest of the stands.

0457 Seth, S.K; Yadav, J.S.P. 1959. **Teak soils**. Indian Forester 85(1): 2-16.

Reviews the literature on teak forest soils, for both natural and artificial forests, with reference to India, Pakistan, Burma, and Indonesia, indicating the optimum conditions of soil, elevation, topography, moisture, nutrients etc. for teak growth and the relationship between geological formations and the composition and distribution of teak forests, teak's requirements as regards pH and lime, and soil deterioration under pure teak plantations.

0458 Shanmughavel, P; Francis, K. 1998. **Litter production and nutrient return in teak plantation**. Van Vigyan 36(2/4): 128-133.

Data are reported on litter production and nutrient return from a 9-yr-old pure teak plantation in Erode District, Tamil Nadu. Leaf litter made up 76-92 percent of the total litter. Nutrient contents of the leaves, twigs and reproductive parts were in the order Ca K N Mg P, whereas in the bark the order was Ca N Mg K P. Nutrient returns from litter in kg/ha were N 136.94, P 1.64, K 114.86, Ca 215.68 and Mg 118.32.

0459 Sharma, S.C; Pande, P.K. 1989. **Patterns of litter nutrient concentration in some plantation ecosystems**. Forest Ecology and Management 29(3): 151-163.

Patterns of litter nutrient concentration were studied in plantations of sal, teak, pine and eucalypts at Dehra Dun, India. Concentration of Ca and N were greater than K, Mg and P in all fractions of litter irrespective of species. Variation in concentration of leaf-litter nutrients is not a species' attribute but depends upon the combined effect of soil nutrient status, growth of the stand and tree growth formations.

0460 Singh, A.K; Ambasht, R.S. 1980. **Production and decomposition rate of litter in a teak (*Tectona grandis*) plantation at Varanasi**. Revue d'Ecologie et de Biologie du Sol 17(1): 13-22.

Leaf and non-leaf litter fall in a teak plantation in Varanasi forest division, India, were measured during a 12 month period. Maximum leaf litter fall occurred in February (65.7 gm-2) and non-leaf litter in March (9.8 gm-2). The maximum monthly decomposition (11.25 g), CO_2 evolution (114.97 mg CO2 m-1 hr-1) and moisture content (51.21) of litter occurred in September. 90.68 of the total litter was decomposed in the year of its production.

0461 Singh, M. 1997. **Effect of nitrogen, phosphorus, potassium and soil working on the growth of teak plants**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 43-45. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Sites in clear-felled, first rotation teak plantation were selected and experiments on the effect of different levels of nutrients and soil working on growth of 6 months old teak plants were carried out. Urea, Rock Phosphate, and muriate of Potash were applied at 3 levels. Soil working at 30, 45, and 60 cm radius around the plants was done. Due to the addition of nutrients, more than 60 per cent increase in height of plants over control was observed. Maximum increment recorded over control was 78.4 cm. NPK at the dose of 30g N+6g P+3G K was found to be the optimum. Soil working also resulted into a height increment of more than 80 percent over control.

0462 Singh, O; Sharma, D.C; Rawat, J.K. 1993. **Production and decomposition of leaf litter in sal, teak, Eucalyptus and poplar forests in Uttar Pradesh**. Indian Forester 119(2): 112-121.

Leaf litter plots (10X10 m) were laid out in November 1990 in a 90-yr-old natural sal (*Shorea robusta*) forest and in plantations of teak (*Tectona grandis*, 15 yr old) *Eucalyptus hybrid* [*E. tereticornis*] (6 yr old) and poplar (*Populus deltoides*, ONDA clones, 4 yr old) at Ram Nagar in NW Uttar Pradesh. Litter collections were made quarterly from 3 plots per stand. Decomposition and nutrient studies were also undertaken: (1) using the nylon bag technique - 16 bags were placed on the forest floor in each stand, and 4 bags sampled quarterly from each; and (2) by analysing forest floor samples consisting of fresh, partially or completely decomposed leaf material collected from 50X50 m quadrats in each stand. Maximum litterfall in sal was in mid-February to mid-May, in teak in mid-November to mid-February and in poplar in the winter; leaf shedding was more or less continuous in *E. tereticornis*. Annual amounts of leaf litterfall were 6.86, 7.70, 6.51 and 5.29 t/ha (dry weight) in sal, teak, *E. tereticornis* and poplar, respectively. Decomposition rate (K) was highest in sal (2.01), followed by teak (1.26), poplar (1.05) and *E. tereticornis* (0.69); these rates were slightly higher than those calculated on the basis of forest floor accumulations. Time required to reach steady state accumulation was also calculated. The mineralization of the major nutrients (N, P, K, Ca, Mg) in each stand is discussed.

0463 Sinha, A; Pathak, S.K. 1995. **Relationship between microbial population and carbon dioxide evolution from decomposing leaf litter of teak (*Tectona grandis* Linn.f.)**. New Agriculturist 6(2): 129-133.

Leaf litter of *Tectona grandis* was collected from the Chandraprabha Sanctuary of Varanasi forest division and its decomposition was studied by keeping the litter in nylon net bags. Population densities of fungi, actinomycetes and bacteria and CO2 evolution from decomposing litter were estimated monthly. In August the highest build up of fungal (82.72 X 104/g of dry litter), actinomycetous (37.04 X 106/g of dry litter) and bacterial (166.67 X 104/g of dry litter) populations coincided with the period of maximum CO2 evolution (119.96 ± 4.82 mg CO2/m2/h). CO2 evolution from decomposing litter was highly correlated with (1) fungal population (r = + 0.8584 P 0.001), (2) actinomycetous population (r .

0464 Sujatha, M.P; Jose, A.I; Sankar, S. 2003. **Leaf litter decomposition and nutrient release in reed bamboo (*Ochlandra travancorica*)**. Journal of Bamboo and Rattan 2(1): 65-78.

Results of a study conducted on the *in situ* reed (*Ochlandra travancorica*) leaf litter decomposition at two selected sites: a pure reed patch and a teak plantation with reed undergrowth in Vazhachal, Kerala are presented.

0465 Suwannaratana, S. 1999. **Comparison of teak and pine plantations in northern Thailand. Thesis: 135p**. Universitat des Saarlandes, Saarbrucken, Germany.

Chemical and physical characteristics of soil, ground flora, nutrient cycling and litter decomposition were compared for sample sites in natural teak forest, teak plantations, a degraded teak forest in Ngao district, Lampang and pine plantations in Hot District, Chiang Mai, both sites in northern Thailand. Measurements were made of soil organic carbon, pH, cation exchange capacity and nutrients. The highest organic C content was recorded in the natural *T. grandis* forest and the lowest level was in the 50-year-old *T. grandis* plantation. The net primary production of the ground flora was highest in the degraded teak forest area. Species diversity index of ground flora was highest in the natural teak forest. In terms of ground flora and soil properties, the teak plantations represented a greater ecological benefit to the area than the pine plantations, and with increasing age, plantation ground flora communities become more similar to that of the natural forest.

0466 Swamy, H.R; Proctor, J. 1997. **Fine litterfall and its nutrients in plantations of *Acacia auriculiformis*, *Eucalyptus tereticornis* and *Tectona grandis* in the Chikmagalur District of the Western Ghats, India**. Journal of Tropical Forest Science 10(1): 73-85.

A study was made of the soil properties and litterfall in plantations of *Acacia auriculiformis* , *Eucalyptus tereticornis* and *Tectona grandis* in Karnataka, India. All the sites had nutrient-rich soils and occurred under a highly seasonal climate with mean annual rainfall of 2003 mm (Tectona). The mean annual total fine litterfall was Tectona 11.4 t ha-1. The litterfall was seasonal with the highest peaks in the dry season in the case of teak and eucalypts.

0467 Tamboli, R.A; Vagyani, B.A. 2001. **On the occurrence of fossil *Tectona* leaf from Aundh, district - Satara, Maharashtra**. Advances in Plant Sciences 14(1): 209-210.

The paper gives an account of fossil leaf impression found in the calcareous tufaceous deposit found near Aundh in Satara district of Maharashtra. The locality belongs to Sub-Recent-Late Plaeistocene period. Several leaf impressions are exposed. A specimen closely agrees with the characters of *Tectona grandis* is described.

0468 Thaiutsa, B; Suwannapinunt, W; Kaitpraneet, W. 1978. **Preliminary study of production and chemical composition of forest litter in Thailand**. Forest Research Bulletin 52: 32p. Kasetsart University, Bangkok.

Data are presented from teak, bamboo, dry dipterocarp and hill evergreen forests, and from a 12-yr-old pine plantation in central and northern Thailand. Nitrogen content was highest in litter from dry dipterocarp forest and lowest in that from hill evergreen forest. Nitrogen and potassium contents of litter were lower at higher altitudes.

0469 Vyas, L.N; Garg, R.K. 1976. **Litter production and nutrient release in deciduous forest of Bansi, Udaipur, India**. Flora German Democratic Republic 165(2): 103-111.

Tabulates the litter fall, nutrient content of the litter and estimated release of nutrients from the litter to the soil for fourteen tree species in dry deciduous forest dominated by *Tectona grandis*. Estimated annual nutrient release varied from 78.42 kg/ha for Ca to 3.92 kg/ha for Na, decreasing in the order Ca, N, K, Mg, P, Na. Observations suggest that leaves of *T. grandis* release the greatest amounts of Ca, N, Na and K.

0470 Xue, L; Chen, H.Y; Bi, H.Y; Tan, S.M. 2002. **Soil nutrient, microorganism and enzyme activity in pure stands of Acacia mangium and *Tectona grandis***. (Chinese). Journal of South China Agricultural University 23(2): p93.

Go top

Soil Microorganisms

(See also 0429, 0448, 0454, 1588)

0471 Amakiri, M.A. 1977. **Effect of herbicides on microbial populations and activities in soils under teak (*Tectona grandis* Linn.f.) plantation**. East African Agricultural and Forestry Journal 42(4): 420-426.

Soil samples taken from a teak plantation in Nigeria were moistened to field capacity with one of three herbicides of chloroxuron, metabromuron, fluometuron at 0.25, 0.5, 1.0 or 2.0 p.p.m. The total numbers of bacteria and of Nitrosomonas and Nitrobacter were assessed and NO3-N, NO2-N and NH4-N were analysed. Both stimulatory and inhibitory effects on the microbial population were observed, depending on the herbicide, its concentration and the period of incubation. Nitrosomonas was more sensitive to the herbicides than Nitrobacter.

0472 Askary, T.H; Ali, M.S; Haider, M.G. 2000. **Occurrence of plant parasitic nematodes on forest plantations in North Bihar**. Journal of Research, Birsa Agricultural University 12(2): 263-264.

A survey was conducted in the Pusa region in North Bihar to determine the types and densities of nematodes associated with forest plantations. Pratylenchus, Meloidogyne, Hoplolaimus, Rotylenchulus and Paratylenchus were found in varying populations infesting different forest plants. Total nematode population varied from 145 to 1460 per 500 g soil, the highest population was around *Tectona grandis*. Teak had the highest population of Tylenchorenchus, Helicotylenchus, Meloidogyne and Rotylenchus.

0473 Badejo, M.A; Ola-Adams, B.A; Sharma, K. 2000. **Abundance and diversity of soil mites of fragmented habitats in a biosphere reserve in southern Nigeria**. Pesquisa Agropecuaria Brasileira 35(11): 2121-2128.

Soil samples were collected from the top 7.5 cm of soil in a Strict Natural Reserve, a surrounding buffer zone, a cassava farm and matured plantations of Gmelina, teak and pine to determine if plantation establishment and intensive cultivation affect the density and diversity of soil mites. A total of 41 taxonomic groups of mites were identified. Teak was dominated by predatory mesostigmatid .

0474 Basu, S; Pati, D.P; Behera, N. 1992. **Microfungal biomass in some tropical forest soils of Orissa, India**. Forest Ecology and Management 55(1/4): 333-339.

An investigation was carried out to estimate microfungal biomass and its relation to soil organic matter content in nine different tropical broadleaved forest soils from Orissa. Dominant tree species were *Tectona grandis* and *Shorea robusta*. There was a significant positive relation between microfungal biomass and soil organic carbon concentration.

0475 Bhadraiah, B; Kanakadurga, V.N; Ramarao, P; Manoharachary, C. 2002. **Effect of AM fungi and rock phosphate on phosphatase activities in *Tectona grandis* Linn.f.** Frontiers in microbial biotechnology and plant pathology: 259-262. C. Manoharachary; D.K. Purohit; S.R. Reddy; M.A.S. Charya; S. Girisham, Eds. Scientific Publishers, Jodhpur.

Seedlings of *T. grandis* grown in polythene bags in sterilized soil were treated with *Glomus mosseae, G. fasciculatum* and rock phosphate (P) separately and also in various combinations. The root and shoot tissues of treated plants were analysed for the acid and alkaline phosphatases. Acid phosphatase activity greatly increased in Gm+Gf+P-treated roots followed by Gf and Gf-treated roots, while in shoots, the activity was maximum in P-treated plants followed by Gf+Gm+P- and Gm+Gf-treated plants.

0476 Chandra, K.K; Jamaluddin. 1999. **Dynamics of VAM infectivity and their population under different seasons in teak and bamboo plantations of Chandrapur (M.S.)**. Vaniki Sandesh 23(1): 16-20.

Seasonal variations in rhizosphere vesicular arbuscular mycorrhizal (VAM) spores and in root VAM infection were studied in a teak seed production area in Maharashtra. The mycorrhizal fungi present were *Glomus* spp., *Acaulospora scrobiculata*, Gigaspora, Scutellospora and Sclerocystis; *Glomus* spp. were the most common. In teak the maximum number of rhizosphere VAM spores were found in the summer and the least in spring and winter.

0477 Chandra, K.K; Ujjaini, M.M. 2002. **Interaction of A M F with three levels of soil organic matter and their influence on seedling biomass and root infection of six forest species**. Myforest 38(2): 155-161.

Mycorrhizal fungi were inoculated with three levels of soil organic matter in species including *Tectona grandis* seedlings. Addition of organic matter in soil was found to enhance the plant biomass. But it decrease the responsiveness to mcycorrhizal fungi. Mycorrhizal infection was increased in non-inoculated plants, while decreased in inoculated plants with increasing level of organic matter in soil.

0478 Chong, L. 1988. **Occurrence of mycorrhizae in seedlings of some tree species in Sarawak**. Mycorrhiza for Green Asia. Proceedings of the 1st Asian Conference on Mycorrhizae, Madras, 29-31 January 1988: 70-72. A. Mahadevan; N. Raman; K. Natarajan, Eds.

Roots of twenty five species of seedlings from the Oya Road nursery and twelve species from the Niah Research Station nursery were examined for mycorrhizal infection. Endomycorrhizal fungi were observed in twenty five species including *Tectona grandis* seedlings having little effect on root morphology.

0479 Coster, C. 1921. **Mycorrhiza in some of our trees, particularly that of teak**. (Indonesian; English). Tectona 14: 563-575.

0480 Dadwal, V.S; Soni, K.K; Jamaluddin. 1986. **Rhizosphere microflora of teak (*Tectona grandis*)**. Indian Journal of Forestry 9(1): 59-62.

Soil samples were collected from around the roots of plants aged 3-6 months, 2 or 10 yr, grown in Madhya Pradesh. Fungi were cultured and identified and results tabulated. The greatest number of species were cultured from rhizosphere samples from 3- to 6-month-old seedlings.

0481 Das, P.K; Nath, S; Banerjee, S.K. 1991. **Distribution of microorganisms in soils under different forest cover at different altitudes**. Indian Agriculturist 35(4): 217-223.

The distribution of bacteria, actinomycetes and fungi was studied in the litter layer and mineral soil layer under different vegetative cover including teak at different altitudes in the Himalayan region of West Bengal. In the lower hill region under *T. grandis* and *S. robusta* the surface soil layer had a higher number of bacteria, actinomycetes and fungi than the subsurface layers. The distributions and numbers of microorganisms in the soil horizons under different vegetation varied considerably. The highest numbers of bacteria and actinomycetes were found in the surface soil under *T. grandis*.

0482 Dhar, P.P; Mridha, M.A.U. 2003. **Status of colonisation and spore population of Arbuscular mycorrhial fungi in *Tectona grandis* Linn.f. from Bangladesh**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

The status of colonization of Arbuscular Mycorrhizal (AM) fungi in the roots and spore population in the rhizosphere soils of teak were assessed. Roots and rhizosphere soils of teak plants both from nursery and plantations were collected from different areas of Bangladesh. Biodiversity of structural colonization in the roots and AM fungal spore population in the rhizosphere soils of teak growing areas highlights the dependency of teak on arbuscular mycorrhizal fungi.

0483 Durga, V.V.K; Gupta, S. 1995. **Effect of vesicular arbuscular mycorrhizae on the growth and mineral nutrition of teak (*Tectona grandis* Linn.f.)**. Indian Forester 121(6): 518-527.

The effect was studied of the VAM fungi *Glomus fasciculatum* and *Glomus mosseae* ± rock phosphate on initial establishment and mineral nutrition of 3 month old teak stumps in polybags. Measurements were made of the uptake of various macronutrients of N, P, K and micronutrients of Cu, Zn, Fe, Mn, and of various growth parameters. *G. mosseae* + *G. fasciculatum* treated plants had greater growth and also showed an increase in concentrations of phosphate, K and Mn, while N, Cu, Zn, Fe concentrations decreased in the shoots. The possible role of VAM in the growth of teak is discussed.

0484 Faiqoh, M.N; Nor Aini, A.S; Azizah, H; Halimi, M.S. 2001. **Physiological changes of *Tectona grandis* Linn.f. and *Gmelina arborea* Roxb. through arbuscular mycorrhizal symbiosis**. Tropical forestry research in the new millennium: Meeting demands and challenges. Proceedings of the International Conference on Forestry and Forest Products Research, 1-3 October 2001, Kuala Lumpur: 545-546. Forest Research Institute Malaysia, Kuala Lumpur, Malaysia.

0485 Gong, M.Q; Wang, F.Z; Chen, Y; Liang, K.N. 2002. **Research on mycorrhiza of *Tectona grandis* and its effect on seedling growth**. Forest Research 15(5): 515-520.

An investigation of sites in three provinces of South China show that all the root samples of teak were infected by arbuscular mycorrhizal fungi in the natural condition. Teak seedlings inoculated artificially by AMF and the infection rate was compared with the infection in natural condition. It is found that the height, ground diameter and biomass of inoculated seedlings increased compared with the control seedlings.

0486 Gurumurthy, S.B; Sreenivasa, M.N. 1998. **Screening and selection of efficient VA mycorrhizal fungus for teak (*Tectona grandis* Linn.f.)**. Karnataka Journal of Agricultural Sciences 11(4): 956-960.

An investigation was carried out to select an efficient VAM fungus that improves growth, nutrition and dry matter production of teak in unsterile soil. Per cent root colonization, mycorrhizal spore counts, population of free living N2-fixers and P-solubilizers were significantly higher in the rhizosphere of teak plants inoculated with *Sclerocystis dussii* as compared with the other VAM fungi tested. An increase in plant height, stem diameter, leaf area, root length, shoot dry weight, root dry weight and the concentrations of P, Zn, Cu, Mn and Fe is noted in shoots which also greatest in plants inoculated with *S. dussii*.

0487 Gurumurthy, S.B; Sreenivasa, M.N. 2000. **Occurrence and distribution of VAM fungi in the rhizosphere of five tree species grown under agroforestry system**. Environment and Ecology 18(2): 500-502.

A survey was conducted to isolate the predominant native VAM fungi in northern Karnataka in the rhizosphere of five tree species, namely, teak, silver oak, casuarina, shisham and tamarind. Two predominant VAM spore types were observed in the rhizosphere soils of teak and silver oak.

0488 Hossain, S.M.Z; Anwar, M.N. 1996. **Isolation of cellulolytic microorganisms from forest and garbage soil and screening for cellulase activity. I. The cellulolytic bacteria**. Bangladesh Journal of Botany 25(1): 19-24.

The isolation and study of cellulolytic microorganisms from the soil under a *Tectona grandis* forest plantation with many other plantations and a garbage centre located in Chittagong, Bangladesh is described. Seventy-one bacterial colonies are detected using Czapek's medium. Five selected bacterial strains are studied in detail for cellulase activity, saccharification, biomass production and their identification is also attempted.

0489 Hossain, S.M.Z; Anwar, M.N. 1996. **Isolation of cellulolytic microorganisms from forest and garbage soil and screening for cellulase activity II: The cellulolytic fungi**. Chittagong University Studies, Science 20(1): 83-88.

An attempt was made to isolate and study the cellulolytic microorganisms from the soil under *Tectona grandis* plantations along with many other plantations and a garbage centre located at Anandabazar in Chittagong, Bangladesh. 35 fungal colonies were detected. Of these, 3 fungal strains were selected and studied in detail for cellulase, saccharification and biomass production, Their identification was also attempted.

0490 Jamaluddin; Chandra, K.K. 1997 . **Distribution of VAM fungi in bauxite mine overburden plantation of Amarkantak (Madhya Pradesh)**. Indian Forester 123(5): 412-418.

A study was made of VAM fungi in the soil, tree root colonization and tree growth in plantations of 11 species including teak. Measurements of tree growth and soil VAM fungi and colonization were made in plantations of the same tree species in a nearby degraded forest area, and of VAM fungi in adjacent barren bauxite overburden. The forest plantations enhanced the VAM population.

0491 Johnston, A. 1949. **Vesicular arbuscular mycorrhiza in Sea Island Cotton and other tropical plants**. Tropical Agriculture, Trinidad 26(7/12): 118-121.

Many species including teak were found to be infected in varying degrees by Vesicular-arbuscular mycorrhizae. Two types of endophyte were recognized, differing in the mode of degeneration of the fungus in root cells. These are termed the `sporangiolar' and `intracellular hyphal'.

0492 Kalshoven, L.G.E. 1941. **Influence of local microscopic fauna, in particular termites, on the fertility of soil**. (Dutch; English). Tectona 34: 568-582. Agricultural University, Wageningen.

0493 Kama, M; Singh, C.S. 1970. **Studies on soil fungi from teak forests of Gorakhpur. VIII. A comparison of fungi of earthworm casts, termitarium and surrounding soil from a teak stand**. Annales de l' Institut Pasteur, Paris 119(2): 249-259.

The fungus population was rich in the surrounding soil. Earthworm casts, which were rich in nutrients, contained fewer fungi imperfecti such as *Aspergillus* and *Penicillium* spp. Phycomycetes were most abundant in the surrounding soil and least in the termitaria, which consisted mainly of wood particles.

0494 Kamal; Bhargava, K.S. 1973. Studies on soil fungi from teak forests of Gorakhpur. X. Edaphic factors and distribution of soil microfungi in teak stands of different ages. Proceedings of the National Academy of Sciences, India B 43(1/2): 9-16.

0495 Kosol, S; Manoch, L; Tangtham, N; Boonyawat, S; Oates, C.G. 1999. **Biodiversity of micro fungi in soil, water and plant under teak plantation of Linthin Watershed Kanchanaburi Province**. (Thai). The 37th Kasetsart University Annual Conference, 3-5

February 1999: 211-216. Text and Journal Publication, Bangkok.

The microfungi isolated from teak plantations were of 11 species of Ascomycete, 4 Coelomycetes, 99 Hyphomycetes, 5 Zygomycetes, 25 unidentified species and 20 species of sterile hyphae.

0496 Manna, M.C; Jha, S; Ghosh, P.K; Acharya, C.L. 2003. **Comparative efficacy of three epigeic earthworms under different deciduous forest litters decomposition**. Bioresource Technology 88(3): 197-206.

Examined the influence of certain tropical epigeic earthworms on the decomposition processes of forest litters including teak. The results indicated that teak litter was the most suitable food material for the earthworms because of high reserves of mineral nutrients in teak.

0497 Mohanan, C. 2003. **Mycorrhizae in forest plantations: Association, diversity and exploitation in planting stock improvement**. KFRI Research Report 252: 133p. Kerala Forest Research Institute, Peechi.

A survey on mycorrhizal association in forestry species raised in plantations/plots and natural stands in different parts of the State was made and their mycorrhizal status and mycorrhizal dependency were studied. *Tectona grandis* was one of the species studied. Teak exhibited a high level of AM fungal association in most of the 70 plantations surveyed. Laboratory and nursery trials were carried out to improve the planting stock of selected tree species including teak using arbuscular mycorrhizal fungi. Seedling height as well as total biomass are reported increased in AM fungal treated seedlings.

0498 Mohanan, C; Sheeba, K.K. 2003. **Productivity of teak stands in Kerala: Role of arbuscular mycorrhizal association and diversity of AM fungi**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

A survey on mycorrhizal association in teak plantations in different parts of Kerala state was made. The root infection as well as AM fungal species association varied with age of the plants and soil physical and chemical properties. Soil pH, soil moisture contents and soil nutrient status were found influencing the AM fungal root colonization and distribution of spores in rhizosphere soil.

0499 Moureaux, C. 1972. **Microbiology as a factor in the solubilization of minerals derived from a ferralitic soil in Madagascar and from biotite in the presence of tropical litter (*Tectona grandis* and *Melaleuca leucadendron*).** Revue d'Ecologie et de Biologie du Sol 9(3): 539-547.

The microbiological solubilization of Fe, Al, Ca, Mg, K and SiO_2 was studied by comparison with sterile replicas from a ferralitic soil in Madagascar and from biotite. The microbiological action was marked in the case of Fe, especially with *T. grandis* litter.

0500 Naha, S.K; Rahman, M.S; Anwar, M.N. 1998. **Cellulolytic microorganisms of soil under deciduous and evergreen forest at Chittagong University Campus**. Bangladesh Journal of Forest Science 27(1): 42-48.

Microorganisms were isolated from the soil under two deciduous including *Tectona grandis* and two evergreen forest plantations in Bangladesh. The relationships of these organisms to soil properties was investigated. Maximum cellulolytic activity of fungi and actinomycetes was recorded in teak soil. Soil moisture and pH were highest under *T. grandis*.

0501 Naik, S.T; Devar, K.V; Suryanarayana, V; Raichur, R.G. 2001. **Seed mycroflora of some important tree species**. Indian Journal of Forestry 24(1): 8-11.

Data are presented on the microbial flora associated with the seeds of different forest tree species including teak studied using the Blotter test and Agar plate technique.

0502 Odu, C.T.I; Adeoye, K.B. 1970. **Heterotrophic nitrification in soils-a preliminary investigation**. Soil Biology and Biochemistry 2(1): 41-45.

Fungi and bacteria isolated from soil samples from soil in a 16-year teak plantation in Nigeria were found capable of producing nitrite and nitrate, or both, in a glucose/peptone medium, soil organic matter extract or sterilized soils. The ecological importance of heterotrophic nitrification is briefly considered.

0503 Okoegwale, E.E. 1983. **The influence of *Tectona grandis*, *Gmelina arborea*, temperature and moisture on microbial population dis-**

tribution. Thesis Summary. Forestry Abstracts 44(10): p608.

0504 Paroha, S; Chandra, K.K; Tiwari, K.P. 2000. **Synergistic role of VAM and Azotobacter inoculation on growth and biomass production in forestry species**. Journal of Tropical Forestry 16(1): 13-21.

One month old seedlings of *Tectona grandis* along with other species in the nursery were inoculated with VAM and with culture of *Azotobacter chroococcum*. The inoculated seedlings exhibited improved growth and biomass. Root development was maximum either with VAM or with VAM + Azotobacter. By mycorrhization, biomass of *T. grandis* doubled.

0505 Parthiban, K.T; Rai, R.S.V. 1993. **Effect of some tree species on rhizosphere microflora**. Advances in Forestry Research in India 8: 91-105.

Reports the rhizosphere microflora around seven species including teak raised as woodlots at Coimbatore, Tamil Nadu.

0506 Rahman, M.F; Jairajpuri, M.S; Ahmad, W; Ahmad, I. 1986. ***Amphibelondira* gen. n. (Nematoda: Belondiroidea) from Bhutan**. Indian Journal of Nematology 16(2): 149-151.

Amphibelondira bhutanensis n.g., n.sp. collected from around the roots of teak in Bhutan is described with illustrations.

0507 Rahman, M.S; Khan, N; Mridha, M.A.U; Hossain, M.K. 2000. **Arbuscular mycorrhizal colonization in teak (*Tectona grandis* Linn.f.) seedlings grown from pre-sowing treated seeds**. Journal of Science 24(2): 33-38.

0508 Rajan, S.K; Reddy, B.J.D; Bagyaraj, D.J. 2000. **Screening of arbuscular mycorrhizal fungi for their symbiotic efficiency with *Tectona grandis***. Forest Ecology and Management 126(2): 91-95.

A study was conducted under nursery conditions to study the efficacy of nine arbuscular mycorrhizal fungi on *Tectona grandis*. Teak seedlings raised in the presence of AM fungi generally showed an increase in plant growth and plant nutritional status over those grown with no soil inoculation of AM fungi. The extent of growth and nutritional status enhanced by the AM fungi varied with the species of fungus.

0509 Raman, N; Nagarajan, N; Sambanandan, K; Gopinathan, S. 1997. **Vesicular arbuscular mycorrhizal association with teak plantations in Yercaud Hills, Tamil Nadu, India**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 247-250. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Vesicular arbuscular mycorrhizal (VAM) association in teak trees and the physio-chemical characteristics of the rhizosphere soil in Tamil Nadu were studied Eight species of *Glomus*, two *Gigaspora* and one species of *Sclerocystis* were encountered in the rhizosphere soil.

0510 Ramanwong, K; Sangwanit, U. 2000. **Effect of vesicular arbuscular mycorrhizal fungi on the growth of teak seedlings**. Bio technology applications for reforestation and biodiversity conservation. Proceedings of the 8th International Workshop of BIO REFOR, Kathmandu, Nepal, 28 November-2 December 1999: 119-122. M.S. Bista; R.B. Joshi; S.M. Amatya; A.V. Parajuli; M.K. Adhikari; H.K. Saiju; R. Thakur; K. Suzuki; K. Ishii, Eds. BIO REFOR, Ministry of Forests and Soil Conservation, Kathmandu, Nepal.

Teak seedlings produced by a tissue culture technique were inoculated with the six species of vesicular-arbuscular mycorrhizal (VAM) fungi, *Acaulospora scrobiculata, Glomus aggregatum, G. deserticola, G. multicaulis, Sclerocystis microcarpus* and an unidentified species. The inoculated teak seedlings showed greater height, diameter at root collar, shoot dry weight, root dry weight and total dry weight than the control seedlings.

0511 Saksena, S.B. 1955. **Ecological factors governing the distribution of soil micro-fungi in some forest soils of Sagar**. Journal of Indian Botanical Society 34: 262-298.

An ecological study of the micro-fungi occurring in various types of forest soils-containing teak mixed with other species is conducted and the results are presented.

0512 Shetye, P.K. 1954. **Soil fungi from *Tectona* and *Diospyros* forests**. Bulletin Bot. Soc. Univ. Saugar 6(1/2): 20-23.

Soil fungi were studied on sites where either *T. grandis* or *D. melanoxylon* was dominant. The author isolated 27 spp. belonging to 12 genera, of which 5 spp. are new records for India.

0513 Sugavanam, V; Udaiyan, K; Devraj, P. 1998. **Selection of an efficient vesicular arbuscular mycorrhizal fungi and *Azospirillum* sp. for inoculating *Tectona grandis*.** Indian Journal of Forestry 21(4): 281-284.

The influence of six vesicular-arbuscular mycorrhizal fungi on the growth of seedlings of *Tectona grandis* was tested. Inoculation with individual VAM fungi or *Azospirillum* sp. increased growth, biomass production, root colonization, and tissue N, P and K concentrations and reduced root shoot ratio.

0514 Talukdar, N.C; Thakuria, D. 2001. **Diversity and importance of vesicular arbuscular mycorrhizal fungi in teak (*Tectona grandis*) and gomar (*Gmelina arborea*) plantations of Assam. Tropical Forestry Research: Challenges in the New Millennium.** Proceedings of the International Symposium, Peechi, India, 2-4 August 2000. R.V. Varma; K.V. Bhat; E.M. Muralidharan; J.K. Sharma, Eds: 177-182. Kerala Forest Research Institute, Peechi.

Soils and root samples collected from teak and gomar plantations at 18 locations under 11 reserve forests of Assam were analysed for spore numbers, levels of vesicular arbuscular mycorrhizal fungi colonization and VAMF species. Effect of two common VAMF on teak and gomar stumps was investigated.

0515 Thapa, R; Ganguly, S. 1990. **Association of *Paralongidorus sali* Siddiqi *et al*., a dorylaimid phytonematode, and other nematodes with sal and teak in Dehra Dun District, Uttar Pradesh**. Indian Journal of Forestry 13(1): p65.

A survey carried out indicated the widespread occurrence of the needle nematode *Paralongidorus sali* in sal forests all over Dehra Dun District and in teak plants at New Forest. Populations were higher in sal than in teak. The nematode occurred in seedlings and older trees. Other plant parasitic nematodes found in the soil samples collected included *Xiphinema americanum, Macroposthonia xenoplax, Hemicriconemoides cocophillus* and *Tylenchorhynchus indicus*.

0516 Thapa, R; Ganguly, S. 1993. **Phytoparasitic nematodes associated with some forest plants around Dehra Dun, Uttar Pradesh, India**. Annals of Plant Protection Sciences 1(2): 129-131.

Soil samples were taken from the rhizosphere of seedlings and mature forest plants from around Dehra Dun, Uttar Pradesh and analysed and it is found that *Xiphinema insigne* were predominant on *Tectona grandis*.

0517 Verma, R.K; Jamaluddin. 1995. **Association and activity of arbuscular mycorrhizae of teak (*Tectona grandis*) in central India.** Indian Forester 121(6): 533-539.

Arbuscular mycorrhizal fungi of teak were isolated from 20 different sites in Madhya Pradesh, including nursery, plantation and natural forests, and studies made of the percentage root colonization in the rhizosphere samples, and of the effect of inoculation on teak seedling growth. Genetically superior trees showed heavier root colonization than other trees. Inoculation of seedlings with *G. fasciculatum* or mixed AM fungi showed better height growth, biomass and percentage root infection in the nursery.

0518 Verma, R.K; Kumar, P; Ansari, S.A. 2001. **Comparative physiomorphological performance of half-sib seedlings of ten teak clones under suboptimal and optimal arbuscular mycorrhizal colonisation**. Journal of Tropical Forest Science 13(3): 423-433.

The physiomorphological response of half-sib seedlings of ten teak clones to native and introduced arbuscular mycorrhizal fungi inocula was tested under nursery conditions. The AM fungi inoculum improved root colonisation in all clones, leaf P level, leaf number, stomatal conductance, transpiration rate, photosynthetic rate, water use efficiency, nitrate reductase activity, plant dry weight, seedling volume in certain clones.

0519 Vijaya, T; Srivasuki, K.P. 2001. **Growth enhancement of *Tectona grandis* inoculated with *Glomus macrocarpus* and *Aspergillus niger* and associated effects on microbial population and phosphatase activity in potting mixes.** Indian Journal of Forestry 24(3): 279-283.

The growth response of teak seedlings to inoculation with each of *Glomus macrocarpus* and *Aspergillus niger* and a combination of both was studied in three different organic substrates. The associated effects of inoculation on microbial population and phosphatase activity were also recorded.

0520 Vijaya, T; Srivasuki, K.P. 2001. **Response of micropropagated *Tectona grandis* to dual inoculation with *Glomus macrocarpus* and *Bacillus megatherium*.** Indian Journal of Forestry 24(1): 43-47.

A study was conducted to determine the response of micropropagated teak plantlets to dual inoculation with *Glomus macrocarpus* and *Bacillus megaterium*. The treatments increased the content of P, Ca, Mg, Na and K in micropropagated teak plants. Maximum amount of nutrients were found in the plants inoculated with dual inoculum of *G. macrocarpus* and *B. megaterium*.

Go top

Soil and Water Conservation

0521 Aguilar Molina, C.A. 1977. **Erosion in teak plantations (*Tectona grandis*)**. (Spanish). Sociedad de Ingenieros Agronomos de El Salvador 6(1): 2-4; 6-10.

0522 Baconguis, S.R. 1991. **Evaluation of *Leucaena leucocephala* de Wit, *Tectona grandis* Linn.f., *Pterocarpus indicus* Willd. and *Eucalyptus deglupta* Blume for stream bank stabilization in the Agusan River Basin**. Sylvatrop 1(1): 79-101.

Leucaena leucocephala, *Tectona grandis*, *Pterocarpus indicus* and *Eucalyptus deglupta* were evaluated for their adaptability and erosion control potential on the stream banks of Agusan river basin in the Philippines. The lower erosion rate in plots covered by *T. grandis* was attributed to the species' more developed canopy, thus providing more ground cover than the other two species in protecting the soil from the erosive impact of raindrops.

0523 Bandara, T.M.J; Somasiri, S. 1992. **Influence of land use on catchment runoff and its impact on the village tank water supply in the dry zone**. Tropical Agriculturist 148: 89-95.

The impact of different land use types, namely rainfed shifting cultivation, monoculture teak and forests, was studied on runoff generation. Runoff from teak forest was more than twice that of mixed forest. It is proposed that further evaluation of the usefulness of teak monoculture as a catchment protection measure against soil erosion is required.

0524 Bell, T.I.W. 1973. **Erosion in the Trinidad teak plantations**. Commonwealth Forestry Review 52(3): 223-233.

Teak has been planted in Trinidad for fifty nine years. As a result of repeated burning, most of the coppice and natural regeneration has been killed and soil erosion under the teak crop has caused concern for many years. It is recommended that an undergrowth of mixed species must be maintained and fires must be prevented if serious erosion is to be avoided. Planting of teak in strips of three rows separated by unplanted strips is recommended on a trial basis.

0525 Chunkao, K; Kurat, P; Boonyawat, S; Dhanmanonda, P; Panburana, N. 1976. **Soil and water losses of Mae Huad forests in Lampang**. (Thai). Kasetsart University, Kog Ma Watershed Research Bulletin 28: 51p.

Sediment yields and surface runoff were much greater in the teak plantation than in other cover types. Some data are presented on changes after burning and cutting undergrowth of girth less than 10 cm.

0526 Dabral, B.G; Rao, B.K.S. 1968. **Interception studies in Chir and teak plantations - New Forest**. Indian Forester 94(7): 541-551.

Stemflow, interception, and throughfall were measured in a plantation of *Pinus longifolia* and *Tectona grandis* at Dehra Dun. Mean throughfall and interception were 73.2 percent and 20.8 percent for teak. A direct relation existed between diameter and stemflow in pine, but no relation existed in teak.

0527 Elsenbeer, H; Newton, B.E; Dunne, T; Moraes J.M de. 1999. **Soil hydraulic conductivities of latosols under pasture, forest and teak in Rondonia, Brazil**. Hydrological Processes 13(9): 1417-1422.

The changes of saturated hydraulic conductivity with depth of latosols developed on Precambrian basement rocks under primary rain forest, pasture and teak plantations was investigated in Brazil.

0528 Fazlul Hoque, A.K.M; Hamid, A. 1978. **Soil erosion in teak plantations**. Proceedings of the First Bangladesh National Conference on Forestry, Dacca, 11-15 February 1977: 80-83.

0529 Groof, G De. 1944. **Soil conservation and agriculture policy in the Congo**. Bulletin of Agriculture Congo belge 35: 118-136.

Author reviews the damages of degradation and erosion of tropical rain forest soils. He considers planting of exotic species like eucalyptus, casuarine, teak and other species prepared for rapid growth have advantages due to their more exacting demands on nutrient elements in the soil and have to be planted.

0530 Haque, M.S; Osman, K.T. 1990. **Some aspects of practicing the clearfelling followed by artificial regeneration system in the Cox's Bazar forest division II. Soil erosion in Bangladesh**. Chittagong University Studies, Bangladesh, Science, Part 2, 14(1): 51-57p.

Soil erosion rate in 27-29 year old patch plantations of teak, gamar, jarul and their combinations and a newly clearfelled area of Ukhia Range in the Cox' Bazar Forest Division was evaluated in this study. Erosion intensity was in the order of teak-gamar mixture teak teak-gamar-jarul mixture gamar jarul. The average erosion rate under teak and jarul were 7.2 and 2.66 t/ha/year respectively. In the newly clearfelled area 256 and 102 t/ha soil losses in one year occurred in the gully and replanted areas respectively.

0531 Joeswopranjoto, S. 1957. **Soil conservation in teak plantations in Indonesia**. FAO Teak Sub-Commission, Bandung FAO/TSC-57/29: 5p. FAO, Rome.

The soil conservation problems in the teak forests of Indonesia are discussed. Study on surface run-off and erosion, and taungya system on soil conservation point of view are discussed. The soil conservation measures recommended in the teak forests areas are given and the future problem is highlighted.

0532 Kallarackal, J; Soman, C.K. 1998. **Tree water consumption - an ecophysiological analysis**. Water and nutrient management for sustainable production and quality of spices: Proceedings of the National Seminar, Madikeri, Karnataka, 5-6 October 1997: 141-152. A.K. Sadanandan; K.S. Krishnamurthy; K. Kandiannan; V.S. Korikanthimath, Eds. Indian Society for Spices, Calicut.

Several tree species are interplanted in plantations of spices, mostly for providing shade to herbaceous plants. Tree water use characteristics are important criteria in the management of irrigation in spice plantations. An ecophysiological investigation was undertaken of plantations of different species including *Tectona grandis*.

0533 Kerbert, H.J. 1908. **Is teak harmful?** Tectona 1: 301-304.

0534 Kushalappa, K.A. 1987. **Short note on trenching in teak plantation**. Myforest 23(1): 25-27.

A brief account is given of the Kanara Circle of Karnataka, where the teak plantations are on undulating and steep terrain, and soil erosion is high because of heavy grazing pressure and repeated fires which have led to a lack of natural regeneration and undergrowth. In order to conserve soil and moisture, trenches were dug 6 m apart in the plantations. Lime and mussoriphos were added to each trench to increase soil pH and phosphate status. The trenches had reduced runoff and soil loss for a short period.

0535 Mensbruge, G de la. 1961. **Soil conservation and forest rehabilitation in the savanna regions of the northern Ivory Coast**. (French). Centre Technique Forestier Tropical, Nogent-sur-Marne: 30p.

An account of experimental plantations of Cassia siamea, Tectona grandis, Gmelina arborea and Anacardium occidentale.

0536 Nema, A.G; Khare, A.K. 1992. **Effect of water logging on some forest plants**. Journal of Tropical Forestry 8(2): 187-188.

Root examination of the affected plants showed that damage was caused by asphyxiation. *Leucaena leucocephala*, *Melia azedarach*, *Moringa oleifera, Syzygium cumini* and *Tectona grandis* were found highly susceptible.

0537 Okali, D.U.U; Furtado, J.I. 1980. **Estimating water use by tropical forests: An example from a plantation teak forest**. Tropical ecology and development. Proceedings of the Vth International Symposium of Tropical Ecology: 581-591. International Society of Tropical Ecology, Kuala Lumpur, Malaya.

Gross precipitation, throughfall and stemflow were measured in a 25-yr-old plantation at Ibadan, Nigeria. Annual interception was 21 percent of the gross rainfall of 948 mm, and stemflow under 2 percent. The canopy storage capacity was 0.6 mm; the free throughfall coefficient was high. The calculation of transpiration and total water use by teak is discussed.

0538 Pandit, B.R; Chava, S.R.K; Rao, V.V.S.V. 1991. **Interrelationship of rainfall, throughfall and stemflow in teak forests**. Indian Journal of Forestry 14(4): 287-289.

Annual rainfall, throughfall and stemflow were studied in 7-yr-old teak stands in Dangs Forest near Pimpri and Waghal, Gujarat. Annual rainfall was 1998.9 mm at Pimpri and 1663.0 mm at Waghal. Throughfall at Pimpri and Waghal was 1059.2 mm and

946.6 mm respectively. Stemflow was 513.7 mm at Pimpri and 359.6 mm at Waghal. There was a significant correlation between throughfall and stemflow at both the study localities.

0539 Purwanto, I; Soerjono, R. 1989. **The effects of various soil conservation practices on soil erosion rates and surface runoff under a teak plantation at Bojonegoro**. (Indonesian). Buletin Penelitian Hutan 520: 19-30. Pusat Penelitian dan Pengembangan Hutan, Bogor.

Measurements were made of soil loss by erosion and of runoff in small erosion plots in a 43-yr-old teak plantation in East Java. Soil conservation practices tested were (a) horizontal ditches, (b) ground cover mulches and (c) a vegetative cover of Eupatorium. The most effective soil conservation treatment was c where annual soil loss was only 8.14 t/ha, followed by (b) and (a), with 18.18 and 31.85 t/ha loss respectively.

0540 Rajendrudu, G; Naidu, C.V. 1998. **Effects of water stress on leaf growth and photosynthetic and transpiration rates of *Tectona grandis*.** Biologia Plantarum 40(2): 229-234.

Three month old seedlings of teak grown after transplantation to fertile soil for 5-6 months at Tirupati were subjected to water stress by withholding watering continuously for 3 weeks. The growth rates of height and of length of developing leaves were decreased by about 50 percent during the second week and became negligible during the third week of water stress treatment. The rate of leaf production and internodal elongation were also decreased.

0541 Sabhasri, S. 1966. **Preliminary watershed management research in Northern Thailand**. Vanasarn 24(2): 178-183.

Describes the setting up of a National Committee to deal with catchment management and outlines the preliminary research now in progress. Hydrological studies are in progress in natural and plantation teak and small forested catchments, and on effects of burning etc.

0542 Tampubolon, A.P; Hamzah, Z. 1988. **Effect of water conservation measures on the growth of teak (*Tectona grandis*) seedlings in a low-rainfall zone**. (Indonesian). Buletin Penelitian Hutan, Pusat Penelitian dan Pengembangan Hutan 496: 1-15.

Teak was planted on a site marginally too dry for teak in Situbondo District, E. Java. Height increment over the next 6-11 months was significantly increased by a strip mulch 110 cm wide of black plastic or 60 cm wide of rocks, the plastic mulch being about twice as effective as the rock mulch.

0543 Tangtham, N. 1992. **Soil erosion problem in teak plantation**. Proceedings of the Seminar on 50 Anniversary of Huay-Tak Teak plantation, Bangkok, 5-8 August 1992.

Investigation on soil erosion in teak plantation was carried out. Three factors, ie., burn, fire control and undergrowth cutting were applied to determine their effects on surface runoff and soil erosion. In all conditions of driving force, surface runoff and soil erosion in teak plantation were the largest. Fire control decreased soil erosion in all forest types especially in teak plantation. Fire and steep slop including single canopy storey could be the factors causing such high erosion in teak plantation.

0544 Thomas, T.P; Sankar, S; Sujatha, M.P. 1997. **Quantification of soil and water loss from teak and eucalypt plantations**. KFRI Research Report 126: 35p. Kerala Forest Research Institute, Peechi.

Soil and water loss through surface run-off from a three year old teak plantation at Nilambur and a two year old eucalypt plantation at Thrissur have been quantified. Loss of water through run-off depended mainly on amount of rainfall and its distribution. Run-off water loss from the teak plantation on laterite soil with 8-12 slope was found to be 25-26 of the rainfall. The corresponding loss of soil was 4-15 metric tons per hectare.

0545 Yadav, A.K; Mishra, G.P. 1985. **Chemistry of stemflow and throughfall waters for some tropical dry deciduous forest trees II. Potassium, calcium and sodium**. Journal of Tropical Forestry 1(2): 99-111.

An increase in cation concentration was noted as rainfall passes through tree crowns. Significant variations due to species were observed in K and Ca concentration in stemflow and throughfall. Greater concentration of all three cations were recorded in stemflow than in throughfall. Maximum average concentration were recorded in stemflow and throughfall under *Tectona grandis*. Some significant positive correlations were found between cation concentration and pH and specific conductivity.

0546 Yadav, A.K; Mishra, G.P. 1985. **Chemistry of stemflow and throughfall waters for some tropical dry deciduous forest trees I. pH,**

specific conductivity, nitrogen and phosphorus. Journal of Tropical Forestry 1(1): 51-60.

Stemflow and throughfall samples were collected under 6 species including teak in Madhya Pradesh, central India. Stemflow samples had higher pH, conductivity and N concentration than throughfall and rainfall. There were significant differences among species in conductivity, N and P concentration in stemflow and in conductivity and P concentration in throughfall.

0547 Yadav, A.K; Mishra, G.P. 1985. **Distribution of precipitation under a tropical dry deciduous forest stand of central India**. Journal of Tropical Forestry 1(3): 182-197.

Incident precipitation, stemflow, throughfall and interception loss were recorded during the rainy seasons in mixed forest in Madhya Pradesh. Stemflow for individual trees ranged from 0 to 13 percent of incident precipitation, average stemflow was 6-7 percent of the total rainfall recorded. The amount of stemflow decreased as crown area and stem diameter increased. Average throughfall was 76-80 percent of incident rain, generally increasing as shower size increased. As a percentage of rainfall, interception loss decreased as rainfall increased.

0548 Yadav, J.S.P; Singh, K. 1976. **Effect of forest plantations on water stable aggregates of soil**. Journal of the Indian Society of Soil Science 24(4): 363-368.

Water-stable aggregates under teak, sal, *Pinus roxburghii* and *Acacia catechu* were studied in the Doon valley, Uttar Pradesh. The proportion of large water-stable aggregates was positively correlated with the organic matter content of the surface soil, while the proportion of small aggregates was positively correlated with subsoil clay content.

Go top

Plant Botany

0549 Bor, N.L. 1953. **Manual of Indian forest Botany**. Oxford University Press, London: 301-302.

Teak was dealt with.

0550 Bourdillon, H. 1895. **Forest trees of Travancore**. Forest Department of erstwhile Travancore State: p285.

Reports a tree in Achencoil valley, Travancore District measuring 26 ft. in girth but had a short bole. Also mentions a log of 7 ft. diameter at butt end and 2'6" diameter at a length of 70 ft. giving 900 cft. of timber, and extracted by British Naval Department.

0551 Bourdillon, T.F. 1908. **The forest trees of Travancore**. Travancore Government Press, Travancore: 280p.

0552 Brandis, D. 1907. **Indian trees**. Archibald Constable and Company Limited: 767p.

0553 Cordes, J.W.H. 1916. **Description of *Tectona grandis***. Tectona 9: 851-878.

0554 Coster, C. 1931. **Contributions to the botanical study of teak**. (Dutch; German). Tectona 24: 768-792.

0555 Fischer, C.E.C. 1923. **Descriptive list of the forest flora of the east central Madras**. Beekman, 1949.

0556 Foulkes, G.F. 1895. **Timber trees of South Kanara**.

0557 Gamble, J.S. 1956. **Flora of presidency of Madras**. Adlard and Son Limited, London: 764-765.

0558 Haines, H.H. 1926. **The botany of Bihar and Orissa**. Botanical Survey of India, Calcutta: 710p.

0559 Hooker, J.D. 1897. **Flora of British India 1892-97**. L.Reeve & Company, London: 570p.

0560 Howard, S.H. 1937. **Forest pocket book, 4th edition**. Forest Research Institute, Dehra Dun: 84p.

Gives briefly the silvicultural characteristics of teak, site requirements and notes on its artificial propagation.

0561 Kanjilal, U. 1969. **Forest flora of the Chakrata, Dehra Dun and Saharanpur Forest Division, U.P. revised by B.L. Gupta**. Fourth Edition 1969: 371p.

Describes *Tectona grandis* under Verbenaceae as introduced species in Dehra Dun and New Forest.

0562 Keiding, H. 1985. **Teak, *Tectona grandis*, Linn. F.** Danida Forest Seed Centre, Denmark, Seed Leaflet 4: 21p.

Nomenclature, tree characteristics, reproductive biology, seed and fruit collection, seed processing, storage, pretreatment and testing are discussed.

0563 Kurz, S. 1877. **Forest flora of British Burma**. Superintendent, Government Printing, Calcutta: 259p.

0564 Ridley, N.H. 1923. **The flora of the Malaya Peninsula**. Vol. 2: 617p.

0565 Roxburgh, W. 1874. **Flora Indica**. Thacker and Spink, Calcutta: 202p.

Go top

Plant Chemistry

(See also 0394, 0411, 0425, 0656, 1397, 2294, 2393, 2927, 3046, 4721, 4744)

0566 Adeyeye, A. 1991. **Composition of seed oils of gmelina (*Gmelina arborea*) and teak (*Tectona grandis*)**. Pakistan Journal of Scientific and Industrial Research 34(9): p359.

0567 Agarwal, S.C; Sarngadharan, M.G; Seshadri, T.R. 1965. **Colouring matter of teak leaves: Isolation and constitution of tectoleafquinone**. Tetrahedron Letter, Oxford 30: 2623-2626.

Mature dry leaves extracted with cold Me_2CO.

0568 Aguinaldo, A.M; Ocampo, O.P.M; Bowden, B.F; Gray, A.I; Waterman, P.G. 1993. **Tectograndone, an anthraquinone naphthoquinone pigment from the leaves of *Tectona grandis***. Phytochemistry 33(4): 933-935.

Tectograndone, a pigment derived from the interaction of two prenylated naphthoquinones has been isolated from the leaves of teak.

0569 Ahluwalia, V.K; Seshadri, T.R. 1957. **Special chemical components of commercial woods and related materials. VI. *Tectona grandis*.** Science and Industry 16B: p323.

Alcohol extract of teak heart-wood yielded 0.1 percent tectoquinone (3. metlhy-anthra-quinone), concentration of the ether extract of bark gave about 1 percent of a triterpenoid compound which was identified us betulinic acid.

0570 Ajmal, M; Ali, M.I.M; Anwar, S. 2001. **Sorption studies of heavy metals on teak leaves (*Tectona grandis*) using thin-layer and column chromatographic techniques.** Pollution Research 20(3): 425-428.

0571 Amir Husni, M.S; Mohd Ghazali, H; Suhaimi, W.C; Adzmi, Y. 1996. **Which leaf position in the crown of *Tectona grandis* (teak) should be sampled for fertility (nutritional) evaluation?** Journal of Tropical Forest Science 9(1): 35-43.

The fertility status of leaf tissues of *Tectona grandis* of various age groups and at various positions of the canopy was assessed via foliar sampling and chemical analysis. It is found that elemental levels of N, P, K, Mg, Cu and Zn in the foliage were generally higher in the apex zone, while those of Ca and Mn were higher in the lower tier of the canopy. In general, leaf tissues from either the top or middle tier of the sun-exposed canopy appeared suitable for the evaluation of nutritional status.

0572 Angadi, V.G; Kamala, B.S; Rai, S.N; Parthasarathi, K. 1988. **Effect of deficiency of trace elements on leaf area, chlorophyll level and photosynthetic efficiency in tree-seedlings**. Myforest 24(2): 124-128.

Trace element deficiency was induced in seedlings of 8 species including *Tectona grandis* using a method previously described [Kamala, B.S.; Angadi, V.G.; Parthasarathi, K. Science and Culture 52, 1986: 161-164]. Leaf samples from 8-month-old seedlings were analysed for chlorophyll content, and leaf area and photosynthetic efficiency measured. Data are tabulated for seedlings deficient in Cu, Zn, Mn, Mo and B and for control non-deficient seedlings. All 3 parameters were reduced by deficiency of each trace element. Relations between the parameters and the differential effects of the trace elements are discussed.

0573 Balasubramanian, A; Ravichandran, V.K. 1996. **Allelopathic significance of six agroforestry trees on *Casuarina equisetifolia* growth and nodulation**. Madras Agricultural Journal 83(2): 84-87.

The allelopathic influences of six agroforestry tree species including teak were tested by using extracts of mature leaves in *Casuarina equisetifolia* germination, growth and nodulation. Effects were measured in terms of germination, root and shoot length, dry matter production and vigour index.

Much lower effects was reported for *T. grandis*.

0574 Berquist, G; Rundberg, Og G. 1941. **The occurrence in Sweden of diseases caused by tropical wood**. (Sweedish). Nordisk Hyg. Tidskr 22: 205-220.

Results of a study conducted on allergic inflamations of skin, upper respiratory tract and in conjunctiva of people working with tropical woods are presented. Teak wood is considered as a most frequent cause of such infections. The details of disease and its duration are also discussed.

0575 Bhadoria, H.B.S; Singh, V.P. 1998. **Effect of different treatments on removal of tannins from teak (*Tectona grandis*) leaves**. JNKVV Research Journal 30(1/2): 52-53.

The removal of tannin from teak leaves was studied. Optimum removal was achieved with calcium hydroxide + urea.

0576 Bhattacharjee, A.K; Das, A.K. 1969. **Phytochemical survey of few Mysore plants**. Economic Botany 23(3): 274-276.

The paper presents the screening results for alkaloids, saponins, sterioids, terpenes and tannins of 27 plants of S. Canara district, Mysore, including *Tectona grandis*. In case of teak, when bark was tested it responded for terpenes, saponine and tannins.

0577 Channal, H.T; Kurdikeri, M.B; Sarangamath, P.A. 2000. **Allelopathic effect of tree leaf extracts on germination of sorghum and rice**. Karnataka Journal of Agricultural Sciences 13(2): 338-342.

A study was conducted to evaluate the allelopathic effect of leaf extracts from different tree species which include *Tectona grandis*, all applied 5 and 10 concentration on seed germination, vigour index, seedling length, and seedling dry matter of sorghum and rice. All tree leaf extracts promoted germination in sorghum.

0578 Channal, H.T; Kurdikeri, M.B; Hunshal, C.S; Sarangamath, P.A; Patil, S.A; Shekhargouda, M. 2002. **Allelopathic effect of some tree species on sunflower and soybean**. Karnataka Journal of Agricultural Sciences 15(2): 279-283.

Studies on the allelopathic effect of seven tree leaf extracts including teak at 5 and 10 percent concentration on sunflower and soyabean indicated that germination of sunflower was increased by *Tectona grandis*, *Tamarindus indica* and *Samanea saman*. Seedling length, vigour index and seedling dry matter were also influenced by tree leaf extracts at different concentrations.

0579 Channal, H.T; Kurdikeri, M.B; Hunshal, C.S; Sarangamath, P.A; Patil, S.A. 2002. **Allelopathic influence of tree leaf extracts on greengram and pigeonpea**. Karnataka Journal of Agricultural Sciences 15(2): 375-378.

Fresh leaves of seven tree species including *Tectona grandis* were collected and 5 and 10 percent concentrations of aqueous solutions were prepared. Extracts were tested for their effects on germination of green gram and pigeon pea seeds. Irrespective of the concentrations in green gram, the percent germination was reduced due to *T. grandis*.

0580 Chin, T; Wang, Y. 1947. **The vegetable tannin materials in Taiwan**. Memoirs of Taiwan Forest Research Institute 1: 22-31.

From the trunk bark of teak grown in Formosa the tannin fractions of the total soluble extract determined by Procter's method is 2.09.

0581 Dhand, V; Tripathi, A.K; Manhas, R.K; Negi, J.D.S; Chauhan, P.S. 2003. **Estimation of carbon content in some forest tree species**. Indian Forester 129(7): 918-922.

A study was carried out in the Forest Research Institute Campus in Dehra Dun, Uttar Pradesh to estimate the carbon content of some important species including teak and its responses to the changing climate. *Pinus roxburghii* stored the highest amount of carbon followed by *Pterospermum acerifolium*, *Syzygium cumini* and *Tectona grandis*.

0582 Drechsel, P; Zech, W. 1991. **Foliar nutrient levels of broad-leaved tropical trees: A tabular review**. Plant and Soil 131(1): 29-46.

Foliar nutrients of some 40 tropical and subtropical broadleaved tree species are listed and classified as deficient, low, intermediate, high, and toxic in each case according to the interpretation and evaluation of the author's review. More detailed data are given for *Tectona grandis*.

0583 Estlander, T; Jolanki, R; Kanerva, L. 1999. **Occupational allergic contact dermatitis eczema caused by obeche and teak dusts**. Contact Dermatitis 41(3): p164.

Reported a case of a 56-yr-old non-atopic carpenter from Finland who developed allergic contact dermatitis after working with teak for about 40 years and obeche for about 30 years.

0584 George, J; Kohli, R.C. 1957. **Nitrogen content of the leaves of some Indian trees**. Indian Forester 83(4): 287-288.

Teak leaves collected in July from Dehra Dun reported to have 0.92 percentage of N and 7.28 percentage of ash.

0585 Gopikumar, K; Varghese, V; Vidyasagaran, K. 2001. **Nutrient deficiency studies in teak (*Tectona grandis* Linn.f.) seedlings**. Proceedings of the 13th Kerala Science Congress, State Committee on Science, Technology and Environment, Kerala. M.R. Das, Ed.

0586 Gopikumar, K; Varghese, V. 2004. **Sand culture studies of teak (*Tectona grandis*) in relation to nutritional deficiency symptoms, growth and vigour**. Journal of Tropical Forest Science 16(1): 46-61.

A study is conducted to induce symptoms of deficiency of various nutrient elements in seedlings of teak grown in sand culture. The effects of nutrients on the growth, vigour and nutrient uptake pattern are also investigated.

0587 Grewal, P.S; Sohi, H.S. 1988. **Toxicity of some plant extracts to *Aphelenchoides composticola***. Indian Journal of Nematology 18(2): 354-355.

A. composticola were exposed to 1, 2, 5 and 10 percent concentrations of leaf extract of *Eucalyptus hybrid*, *Leucaena leucocephala*, *Populus deltoides* and *Tectona grandis* for 48, 96 or 144h. Nematode mortality increased with exposure time and concentration with *L. leucocephala* being the most effective.

0588 Gupta, R.S; Patle, B.R. 1991. **Nutritive value of dry fallen teak (*Tectona grandis*) leaves**. Indian Journal of Animal Nutrition 8(1): 67-68.

The contents of dry matter, crude protein, ether extract, crude fibre, nitrogen free extract, total ash, acid insoluble ash, calcium and phosphorus on dry matter basis in dry fallen teak leaves were found out. Average values of digestible crude protein and total digestible nutrients estimated by different methods were 1.44 and 17.82 percent respectively.

0589 Gupta, R.S; Patle, B.R. 1992. **Availability and chemical composition of dry fallen teak (*Tectona grandis*) leaves and possibility of its feeding to ruminants.** Indian Journal of Dairy Science 45(7): 383-384.

Dried, fallen teak leaves contained 7.09 percent crude protein, 22.27 percent crude fibre, 2.81 percent calcium and 0.46 percent phosphorus.

0590 Haupt, M; Leithoff, H; Meier, D; Puls, J; Richter, H.G; Faix, O. 2003. **Heartwood extractives and natural durability of plantation grown teakwood (*Tectona grandis* Linn.f.) - a case study**. Holz als Roh und Werkstoff 61(6): 473-474.

The causes of low natural durability of plantation grown teak from Panama were investigated. A lower content of tectoquinone and a higher one of deoxylapachol is reported in the non durable teakwood.

0591 Hellinga, G. 1955. **The amounts of mineral constituents taken up from the soil by stands of *Tectona grandis* and *Albizia falcata***. (Javanese; Dutch). Rimba Indonesia 4(9/12): 367-377.

Data are given for ash content of the woods of these two species and 31 other species.

0592 Hernandez, R; Torres, A; Marquez, O; Franco, W. 1993. **Foliar nutrient content and growth in teak plantations in Ticoporo, Venezuela**. (Spanish). Turrialba 43(1): 11-15.

The relationship between foliar nutrient content and growth was studied in 12-year-old teak plantations on alluvial soils, in the Venezuelan western plains. The plantation on moderately drained soils showed better growth than the one on poorly drained soils. The K and P foliar contents were significantly greater in the site with moderate drainage, whereas the Mg, Fe and Mn foliar concentration were significantly greater at the poorly drained site. Potassium foliar content was positively correlated with teak growth.

0593 Hooper, D. 1888. **The mineral concretion of the teak tree**. Indian Forester 14(4): 159-161.

The observations of white mineral concretions, mainly lime are reviewed and chemical composition discussed. Watt considers that in teakwood the percentage of carbon and hydrogen are higher than in most woods and with richness of Ca phosphate and silica may account for great hardness of teak. The Nilambur concretion has Calcium carbonate 70.05 percentage, tricalcic orthophosphate 2.89 percentage, quartz sand 9.76 percentage, organic matter 14.30 percentage and moisture 3.0 percentage.

0594 Jadhav, B.B; Gaynar, D.G. 1994. **Effect of *Tectona grandis* (L.) leaf leachates on rice and cowpea**. Allelopathy Journal 1(1): 66-69.

The effects of extracts of dried powdered leaves of *Tectona grandis* were tested on the germination and seedling growth of rice and cowpeas. Germination was significantly reduced in the early stages but less later. The inhibition increased progressively with leaf powder soaking time.

0595 Jain, A; Roychoudhury, N. 1997. **Phytochemistry of teak (*Tectona grandis* Linn. f.): A critical review**. Advances in Forestry Research in India 17: 1-39.

0596 Jain, A; Roychoudhury, N. 2000. **Nutrient assessment in teak leaves of different maturity**. Indian Journal of Forestry 23(2): 155-156.

This work investigated variations in nutrient content of teak leaves of tender, intermediate and mature leaves from a 2-yr-old plant. Leaf moisture content was determined. Leaf protein, chlorophyll, nitrogen, phosphorus, potassium, calcium, magnesium and sodium contents were determined. Moisture content, protein, N, P, K and Na were higher in tender than intermediate and mature leaves. Chlorophyll, Ca and Mg contents were greater in mature than in intermediate and tender leaves.

0597 Jayamadhavan, A; Sudhakara, K; Wahid, P.A. 2000. **Methods of leaf sampling in teak (*Tectona grandis*) for nutrient analysis**. Journal of Tropical Forest Science 12(2): 227-237.

A study was conducted in 10-yr-old teak plantations at Nilambur, Kerala to standardize the canopy height, time of sampling, leaf rank and diameter class of trees from which to collect leaf samples for the determination of N, P and K concentrations. Seasonal variation in the foliar N, P and K concentrations was also determined for a period of 13 months.

0598 Joshi, K.C; Singh, P; Pardasani, R.T. 1977. **Chemical components of roots of *Tectona grandis* and *Gmelina arborea***. Planta Medica 32(1): 71-75.

0599 Jung, H.D. 1967. **Occupational contact eczema with Kambala teak wood**. (German). Deutsche Gesundheitswesen, Berlin 22(45): 2141-2143.

Reports on acute, allergically induced eczema in a workshop; the allergic nature could be proved by skin tests with chips, dust etc. of the wood.

0600 Kenjale, R.Y; Chavan, K.N; Chavan, A.S. 1994. **Recycling of nutrient elements by some forest tree species of Konkan in Maharashtra. I-Foliar and leaf-litter nutrient concentration**. Van Vigyan 32(1/2): 1-6.

The paper describes the results of a study in which mature green leaves and leaf litter were collected from 10-yr-old plantations of seven species, and analysed for content of major nutrients of N, P, K, Ca and Mg. The leaf litter contained less nutrients than green leaves.

0601 Konar, J; Kushari, D.P. 1989. **Effect of leaf leachate of four species on sprouting behavior of rhizomes, seedling growth and diosgenin content of *Costus speciosus***. Bulletin of the Torrey Botanical Club 116(4): 339-343.

The rhizomes of *C. speciosus* were treated with leaf leachates of *Mangifera indica*, *Shorea robusta*, *Tectona grandis* and *Eucalyptus globulus*. Treatment with leaf leachates increased the percentage of sprouting of rhizomes, shortened the sprouting time and promoted subsequent growth except *E. globulus*.

0602 Krishna, A; Manjunath, G.O; Rathod, R; Kannur, S. 2003. **Allelopathic effect of four agroforestry tree species leaf leachates on seed germination of certain vegetable crops**. Karnataka Journal of Agricultural Sciences 16(3): 430-433.

Laboratory experiments were conducted to study the alleopathic effect of leaf leachates of different species including *Tectona grandis* on tomato, aubergine and chilli. The leaf leachates of all trees significantly inhibited germination percentage and growth of vegetable crops.

0603 Krogh, H.K. 1963. **Contact eczema caused by true teak**. British Journal of Industrial Medicine 21(1): 65-68.

Out of 112 furniture factory workers, 21 showed allergic skin reaction to *Tectona grandis* dust, the incidence of contact eczema and severe itching. Patch testing revealed sensitivity to lapachol.

0604 Lalman; Misra, A. 1985. **Nutrient utilization in some tropical forest tree seedlings**. Indian Forester 111(6): 368-384.

The concentration of N, P, K, Ca and Na in seedlings of *Tectona grandis* was evaluated along with other species. Concentration of Na in leaves was higher than that of K, Ca and P and was higher in leaves than in roots and stems. Concentration was found to increase with age of leaves up to 8-9 months after which N, P and K contents decreased rapidly.

0605 Laskar, S; Majumdar, S.G; Basak, B; Maity, C.R. 1985. **Influence of teak (*Tectona grandis*) seed protein on some enzymes and liver lipids of albino rats**. Revista Espanola de Fisiologia 41(3): 331-334.

0606 Leyva, A; Dimmel, D.R; Pullman, G.S. 1998. **Teak extract as a catalyst for the pulping of loblolly pine**. Tappi Journal 81(5): 237-240.

Analysis of teak extract indicated the presence of a variety of napthaquinones and anthraquinones of which 2-methyl anthraquinone was the major component. When used as a catalyst in pulping loblolly pine, the extract was active, based on its 2-methyl AQ content.

0607 Mandal, S; Brahmachary, R.L. 1998. **Growth stimulators in shed leaves of teak (*Tectona grandis*)**. Indian Forester 124(3): 267-269.

Aqueous extracts of dry teak leaves inhibited root and shoot growth of rice seedlings developing from seeds germinated on filter paper soaked in the extracts. Two inhibitors and two stimulators were identified in the extracts after paper chromatographic separation.

0608 Marwani, E; Kobayashi, A; Kajiyama, S.I; Fukusaki, E; Nitoda, T; Kanzaki, H; Kawazu, K. 1997. ***Tectona grandis* callus produces antibacterial triterpene acids not detected in the intact plant**. Natural Product Sciences 3(1): 75-80p.

0609 Masilamani, P; Dharmalingam, C; Annadurai, K. 2002. **Inhibitory effect of water extracts of epicarp and mesocarp of teak on germination of some field crops**. Indian Journal of Forestry 25(1/2): 39-41.

The extracts from mesocarp teak seeds exhibited a significant influence on the germination of soyabean and cowpea seeds but not on rice, sorghum, black gram or green gram. This was because of the presence of some water soluble germination inhibitors in the felty mesocarp.

0610 Nakamura, K. 2002. **Protoplast isolation from leaf teak (*Tectona grandis*)**. (Japanese). Japan Kokai Tokkyo Koho JP 2002253220 A2, 10th September 2002: 4p.

0611 Patil, R.H; Itnal, C.J; Hunshal, C.S. 2003. **Allelopathic effect of tree litter leachates on wheat crop**. Journal of Maharashtra Agricultural Universities 28(2): 182-184.

A laboratory experiment was conducted to determine the effects of eucalyptus, casuarinas and teak tree leachates on wheat seeds. The germination percentage, shoot and root length and shoot and root dry weight per plant were recorded.

0612 Pramono, S. 1995. **Phytochemical and pharmacological approaches of plant ethnobotany used for anti-diarrhea**. Proceedings of the Second National Seminar and Workshop on Ethnobotany, Yogyakarta, Medicinal Plant, Book 1, 1995. R.E. Nasution; H. Roemantyo; E.B. Walujo, S. Kartosedono, Eds.

Phytochemical and pharmacological study of plants revealed that 90 species of plant have been utilized for anti-diarrhea. It is found that their phytochemical properties are suit well with their pharmacological effect, such as *Areca catechu, Psidium guajava* leaf and teak charcoal.

0613 Puri, G.S. 1954. **Foliar constituents in some tree species of *Shorea robusta* forests of the Siwaliks, U.P. India**. Indian Forester 80(11): p700.

Gives the chemical composition of mature leaves of *Tectona grandis* in the sal forest of Dun valley.

0614 Puri, G.S; Gupta, A.C. 1954. **Seasonal variation in foliar composition of some Indian forest trees**. Journal of Indian Botanical Society 33(4): 382-393.

A study of seasonal variation in foliar ash, Ca, Mg and N in *Tectona grandis* was conducted along with other species.

0615 Rajput, K.S; Rao, K.S. 1999. **Seasonal distribution of starch in *Tectona grandis* Linn.f. and *Acacia nilotica* (L.) Del. growing in different forests of Gujarat state.** Phytomorphology 49(2): 209-214.

The distribution of starch was examined using histochemical methods in xylem, cambium and phloem tissues of *Tectona grandis* growing in moist deciduous and dry deciduous forests of Gujarat state. Starch grains were found in ray cambial cells of

Tectona. Their size, distribution and stainability increased concomitantly with the maturation of leaves in both the forests.

0616 Rao, P.S; Misra, A.K; Puri, S.K. 1966. **Dyestuff from teak leaves**. Indian Forest Leaflet 178: 8p.

Reports experiments in the extraction of dyestuff from the leaves and its use in dyeing wool, silk, and cotton, with data on costs and equipment required for cottage-scale industry.

0617 Sareen, V; Jain, S; Narula, A. 1995. **Evaluation of oestrogenicity and pregnancy interceptory efficacy of lapachol (2-hydroxy-3-(3-methyl-2-butenyl)-1,4-naphthoquinone) in the mouse**. Phytotherapy Research 9(2): 139-141.

Lapachol, a naphthoquinone isolated from the heartwood of *Tectona grandis*, was evaluated for its oestrogenicity and antinidational activities in ovariectomized mice. Significant uterophic effects were observed following daily administration of lapachol.

0618 Shirin, F; Sarkar, A.K. 2003. **Removal of phenolic exudates from explants of *Tectona grandis***. Teaknet Newsletter 30: 4-6.

Phenolic exudates from cut ends of explants pose a great problem for establishment of in vitro cultures of *Tectona grandis* and have become the main bottleneck for development of a micropropagation procedure for the species. The collected explants were administered with 0.1 percent solution of various inorganic/organic compounds and adsorbents and activated charcoal prior to their surface sterilization.

0619 Singh, U.P; Singh, S.K; Pathak, N.K.R; Rao, A.L.J; Sarma, B.K. 2002. **Effect of lapachol on conidial germination of *Alternaria tenuissima* (Kunze ex Pers.) Wiltshire, inciting blight of pigeon pea (*Cajanus cajan* (L.) Millsp.)**. Journal of Mycology and Plant Pathology 32(2): 255-257.

About 200-300 conidia of *A. tenuissima* causing blight in pigeon pea were treated with lapachol isolated from *Tectona grandis* to determine the effects of the compound on the conidial germination of the pathogen *in vitro*. *A. tenuissima* conidial germination and germ tube length decreased with increasing concentrations of lapachol *in vitro* and *in vivo*. It is reported that at 2000 ppm, lapachol inhibited the conidial germination of the pathogen.

0620 Sinha, U.S.P; Sinha, A.K. 1993. **Amino acids in the leaves of *Tectona grandis* and Zizyphus *mauritiana*, the secondary food plants of tasar silkworm, *Antheraea mylitta* D.** Indian Journal of Sericulture 32(2): 223-224.

The amino acid compositions of leaves of *Tectona grandis* and *Zizyphus mauritiana* were analysed. The total amino acid contents of teak was 69 100. There were 15 amino acids common to both plants. Arginine, histidine, glutamine, tyrosine and methionine sulfoxide were only found in *T. grandis*.

0621 Sujatha, M.P. 2003. **Diagnosis of micronutrient deficiencies in teak seedlings**. KFRI Research Report 249. Kerala Forest Research Institute, Peechi.

A study was conducted to diagnose the deficiency symptoms of Fe, Cu, Zn, Mn, Mo and B in teak seedlings using sand culture. Deficiency of micronutrients resulted in the retardation of plant growth. The reduction in height at severe stage of deficiency was more in Mo and Cu deficient plants and minimum in B deficient plants.

0622 Swaminathan, C; Sivagnanam, K; Srimathi, P. 1993. **Allelopathic proclivities of multipurpose trees**. Myforest 29(2): 147-149.

An investigation of the allelopathic effects of extracts from the bark of eight multipurpose trees including teak on three arable crops was made and the results are presented.

0623 Sylianco, C.Y.L; Jocano, A.P; Lim, C.M. 1988. **Antimutagenicity of twenty Philippine plants using the micronucleus test in mice**. Philippine Journal of Science 117(3): 231-235p.

Methylmethanesulfonate, mitomycin C and dimethylnitrosamine are genotoxic to bone narrow cells, since they fragment the chromathin material leading to the formation of micronucleated polychromatic erythrocytes in bone narrow cells of experimental mice. Expressions from different species including *Tectona grandis* Linn.f. reduced the induction of micronucleated polychromatic erythrocytes by methylmethanesulfonate, mitomycin C. and dimethylnitrosamine indicating that these plants have antimutagenic effects.

0624 Tripathi, S; Tripathi, A; Kori, D.C. 1999. **Allelopathic evaluation of *Tectona grandis* leaf, root and soil aqueous extracts on soy-**

bean. Indian Journal of Forestry 22(4): 366-374.

The allelopathic activity of *Tectona grandis* was studied in bioassays on the germination, seedling growth, nodulation, and chemical and biochemical parameters of soyabean seeds and seedlings. The extracts exhibited a stimulatory effect on peroxidase activity and nodulation of seedlings and on seed protein. Root extracts enhanced peroxidase activity. Leaf extracts increased nodulation.

0625 Webb, M.J; Reddell, P; Nath, S; Srivastava, R.J. 2001. **Determining P and N status of a tropical timber species (teak): Assessment of 'quick' chemical tests and a root phosphatase assay**. Plant nutrition: Food security and sustainability of agro ecosystems through basic and applied research. Fourteenth International Plant Nutrition Colloquium, Hannover, Germany: 706-707. W.J. Horst; M.K. Schenk; A. Burkert; N. Claassen; H. Flessa; W.B. Frommer; H. Goldbach; H.W. Olfs; V. Romheld, Eds. Kluwer Academic Publishers, Dordrecht, Netherlands.

Assessed the suitability of 'quick' chemical test strips and an assay of root phosphatase activity for assessing the P and N status of seedlings of teak. These tests confirmed the adequacy of nutrient status. The activity of root phosphatase was sensitive to P status; decreasing rapidly with increasing P status. Phosphatase activity can be used to determine the severity of deficiency.

0626 Windeisen, E; Klassen, A; Wegener, G. 2003. **On the chemical characterisation of plantation teakwood from Panama**. Holz als Roh und Werkstoff 61(6): 416-418.

Chemical composition, especially the qualitative and quantitative analysis of extractives focusing on the derivatives of anthraquinone and lapachol is compared of teakwood from two plantations of Panama .

0627 Winter, K; Holtum, J.A.M. 2002. **How closely do the delta13C values of Crassulacean acid metabolism plants reflect the proportion of CO2 fixed during day and night?** Plant Physiology 129(4): 1843-1851.

The extent to which Crassulacean acid metabolism (CAM) plant delta13C values provide an index of the proportions of CO2 fixed during day time and night time was assessed. Shoots of seven CAM species and two C3 species including *Tectona grandis* were grown in a cuvette and net CO2 exchange was monitored and the results are presented.

0628 Yamamoto, K; Simatupang, M.H. 1996. **Location of caout chouc in teak**. Forestry and forest products research: Proceedings of the Third Conference, 3-4 October 1995, Kepong. Volume 2: 247-254. A.M. Abdul Rashid; Abdul Rahim Nik; Aminuddin Mohamad; Lee SuSee; Wong HanHoy; Khoo KeanChoon, Eds. Forest Research Institute Malaysia, Kuala Lumpur.

Thin sections of teak heartwood were extracted with acetone or acetone and chloroform and analysed by X-ray photoelectron spectroscopy. The water repellency of the wood surface was significantly reduced during successive extraction with acetone and chloroform. Caoutchouc extracted with chloroform is responsible for the water repellency of teak wood.

0629 Yamamoto, K; Simatupang, M.H; Hashim, R. 1998. **Caout chouc in teak wood (*Tectona grandis* Linn.f.): Formation, location, influence on sunlight irradiation, hydrophobicity and decay resistance**. Holz als Roh-und Werkstoff 56(3): 201-209.

The distribution of this polyisoprenoid in untreated and extracted heartwood, its influence on surface chemistry, contact angle with water and formation of radicals before and after irradiation with sunlight and on decay resistance were determined.

0630 Yamamoto, K; Simatupang, M.H. 2000. **Formation of caout chouc by wound in teak xylem**. Conference on forestry and forest products research 1997: Proceedings of the Fourth Conference, Malaysia, 24 October 1997: 168-173. S. Appanah; S.Y.M. Yusoff; A.W. Jasery; K.K. Choon, Eds. Forest Research Institute Malaysia, Kuala Lumpur.

Caoutchouc is formed during the transition from sapwood to heartwood in teak xylem. Formation of caoutchouc in response to wounding was examined under microscopy.

0631 Zech, W. 1984. **Leaf analysis - a method to detect mineral deficiencies in fast growing plantations of West Africa**. Proceedings IUFRO Symposium on Site and Productivity of Fast Growing Plantations, Volume 2: 691-699. South African Forest Research Institute, Pretoria, South Africa.

Instances of boron, nitrogen, phosphorus, potassium, zinc and calcium deficiencies are reported for plantations of different species which include *Tectona grandis* in West Africa.

0632 Zech, W; Kaupenjohann, M. 1990. **Potassium and phosphorus deficiencies of *Casuarina equisetifolia*, *Eucalyptus* spp., *Acacia auriculiformis* and *Tectona grandis* in south Benin (West Africa).** (French). Bois et Forests des Tropiques 226: 29-36.

In order to analyse nutrient deficiencies, foliage samples were taken from trees of fuelwood plantations of fast-growing species. Teak growing on vertisols exhibited reduced vigour due to periodic flooding, but no deficiency symptoms. Teak growing on acid ferralitic soils had P and K deficiency symptoms such as chlorosis, necrosis and dieback. It is reported that root decay due to waterlogging may be responsible for these symptoms.

Go top

Plant Physiology

(See also 0716, 0719)

0633 U**nusual flowering of teak seedlings**. Indian Forester 47(4), 1921: p166.

Reported an unusual flowering of 5-6 months old seedlings from Prome Division, Burma.

0634 Bhatnagar, H.P. 1967. **Physiology of forest trees**. Proceedings of 11th Silvicultural Conference, Dehra Dun 1967.

Studies on the nutritional requirements of the seedlings of *Tectona grandis* indicated 4000 lbs./acre of Potassium and Nitrogen, and 200 lbs./acre of Phosphorous.

0635 Bhola, M.P. 1929. **Flowering of teak in Gorakpur**. Indian Forester 55(11): p623.

Reports the flowering of a 1926 teak plantation in 1928 after being planted with one year old stumps. Small sized seeds are produced in January-February 1929, and nuts were smaller than average, 0.2" in diameter, and quantity of seed per sapling few, 2-3 dozens.

0636 Bila, A.D; Lindgren, D; Mullin, T.J. 1999. **Fertility variation and its effect on diversity over generations in a teak plantation (*Tectona grandis* Linn.f.).** Silvae Genetica 48(3/4): 109-114.

Flower and fruit production were used to assess plant fertility in a teak stand in southern Mozambique. The trees varied in fertility, with the 20 percent most fertile trees in the stand producing 55 percent of the gametes. Formulae to calculate inbreeding, group coancestry and status number over generations were derived. Predictions over 10 generations, assuming random mating, showed that inbreeding and group coancestry accumulated rapidly during the first generations while status number decreased. This loss of diversity was hastened by differences in fertility among parents. A way to reduce the loss of diversity suggested was to collect equal amounts of seeds from each seed parent contributing to the next generation.

0637 Boonkird, S. 1966. **Flowering of teak**. Natural History Bulletin of the Siam Society 21(1/2): 69-74.

The paper gives a short account of flowering habit of teak in relation to its effect on branching and height growth and concludes that early flowering among young teak is probably herditary.

0638 Costa, W.A.J.M de; Abeysinghe, W.A.M.W.K.S.B; Chandrapala, A.G. 2000. **Relationship between stomatal conductance and leaf water potential in selected forest tree species growing under different levels of natural shade in the mid-country wet zone**. Journal of the National Science Foundation of Sri Lanka 28(1): 63-78.

Nine forest tree species including *Tectona grandis* growing under different levels of natural shade, i.e. open, medium shade and full shade, were used for measurements. Total leaf conductance (g1) and leaf water potential (PSI) varied significantly with tree species and shade levels.

0639 Coster, C. 1932. **Studies of roots in the tropics 1 and II**. (Dutch; English; German). Tectona 25(9): 641-645; 828-872.

0640 Coster, C. 1933. **Studies of roots in the tropics III**. (Dutch; English). Tectona 26: 450-497.

The factors influencing growth of plants by root competition are lack of (1) soil moisture (2) mineral food and (3) oxygen and perhaps secretion of toxins by the roots. Experiments with variation of above factors in a teak plantation bordering an old forest are described - the problem of root competition was highlighted. It is reported that Lantana reduces increment of teak upto 32 percent, *Leucaena glauca* is the only mixture considered beneficial to teak.

0641 Coster, C. 1935. **Root studies in one tropics-V**. (Dutch; English). Tectona 28(11): 861-878.

0642 Grace, J; Fasehun, F.E; Dixon, M. 1980. **Boundary layer conductance of the leaves of some tropical timber trees**. Plant, Cell and Environment 3(6): 443-450.

The boundary layer conductance was determined by measuring the rate of cooling of brass models of leaves exposed in a wind tunnel. The models were based on juvenile and adult leaves of *Gmelina arborea* and leaves of teak and *Triplochiton scleroxylon*; the teak leaf models were made either with or without projecting veins. Results suggest that teak and *Gmelina* leaves avoid excessive rise in temperature by high stomatal conductance and transpiration.

0643 Kaikini, D.S. 1934. **Branching of teak**. Indian Forester 60(9): 614-615.

Incidence of branching in teak plantations attributes branching to (1) very poor soils on which plantations are grown, (2) damage caused by creepers and climbers by encircling and smothering the leading shoot, and (3) origin of seed, e.g. pole-size teak forest origin from Gund area.

0644 Karmacharya, S.B; Singh, K.P. 1992. **Production and nutrient dynamics of reproductive components of teak trees in the dry tropics**. Tree Physiology 11(4): 357-368.

Floral axes were sampled periodically from 14 and 30-yr-old teak stands growing in the Chakia Range of Varanasi Forest Division, Uttar Pradesh. Flower production per tree was positively related to tree size. Annual production of reproductive components was 245 kg/ha in the 14-yr-old stand and 1122 kg/ha in the 30-yr-old stand. In both stands, relatively greater amounts of dry matter and nutrients were allocated to reproductive parts in September than in other months. Towards the end of the fruit maturation period, considerable nutrient resorption occurred. More than 90 percent of the nutrients accumulated in the peduncle were resorbed.

0645 Madsen, E. 1975. **Determination of moisture content in fruits of teak (*Tectona grandis* Linn.f.)**. (Danish). Beretning fra Statsfroekontrollen 104: 103-108.

0646 Maruyama, Y; Toma, T; Ishida, A; Matsumoto, Y; Morikawa, Y; Ang, L.H; Yap, S.K; Iwasa, M. 1997. **Photosynthesis and water use efficiency of 19 tropical tree species**. Journal of Tropical Forest Science 9(3): 434-438.

Gas exchange measurements were made on one fully expanded mature leaves on each of five seedlings of eleven dipterocarp species and eight non-dipterocarps in a shaded nursery in the Chikus Forest Reserve, Perak, Malaysia. Calculations were made of net photosynthetic rate, transpiration rate, water use efficiency and leaf dry weight per unit area. Water use efficiency was highest in three species including *Tectona grandis* occurring naturally in the northern part of Malaysia. The results are discussed in relation to species choice for various site types.

0647 Matsumoto, Y. 2002. **Leaf physiology of tropical forest trees (3) intrinsic water-use efficiency**. (Japanese). Tropical Forestry 55: 67-71.

Data are presented on water use efficiency for various tropical tree species including *Tectona grandis*.

0648 Nanda, K.K. 1962. **Some observations on growth, branching behaviour and flowering of teak (*Tectona grandis* Linn.f.) in relation to light.** Indian Forester 88(2): 207-218.

The emergence of branches and their flowering appear to be related to ageing or completion of the developmental process of the main shoot or the branch on which these are produced. The first branch emerges from the node immediately below the previous year's inflorescence, and the second one from the node next below it and so on. The flowering of these branches also follows the same order, and this basipetal sequence of emergence and flowering is exhibited even by secondary, tertiary, quaternary, and further branches.

0649 Negi, G.C.S; Singh, S.P. 1992. **Leaf growth pattern in evergreen and deciduous species of the central Himalaya, India**. International Journal of Biometeorology 36(4): 233-242.

Leaf growth patterns were investigated in 11 evergreen species and in 15 deciduous species including teak occurring in Uttar Pradesh. Leaf initiation period, leaf population dynamics, leaf expansion, leaf mass changes, leaf longevity and some other related parameters were investigated over different months/seasons . The results for both groups are compared and discussed.

0650 Ngampongsai, C. 1973. **The distribution and development of teak-root in different age plantations**. (Thai). Faculty of Forestry, Kasetsart University, Thailand, Forest Research Bulletin 28: 63p.

It was found that the rate of increase of the root system declined with increasing age; the roots were confined to the upper 30 cm of the soil surface; with increasing age the tap root lost its ability to penetrate and lateral and vertical roots then developed profusely. Above-ground and below-ground parts of the trees were compared; the patterns of growth were different, but an approximate weight ratio of 5:1 is suggested.

0651 Prasad, R; Mishra, G.P. 1984. **Studies on root system of important tree species in dry deciduous teak forests of Sagar (M.P.)**. Indian Journal of Forestry 7(3): 171-177.

The dimensions of the root systems were measured for eleven sample trees of teak and three associated species. Lateral spread was greatest in *A. latifolia*, followed by *T. tomentosa*, teak and *D. melanoxylon*. Stout and deep tap roots were observed in teak and *T. tomentosa*. Secondary and tertiary roots were prominent but sparse in teak and *T. tomentosa*. The relations between root and crown spread were analysed. In nearly all cases horizontal root spread was greater than crown spread. It is concluded that frequent uprooting in teak is caused by its relatively larger crown. An equation is given for calculating above-ground biomass of teak from root and crown spread.

0652 Rajendrudu, G; Naidu, C.V. 1997. **Leaf gas exchange capacity in relation to leaf position on the stem in field grown teak (*Tectona grandis* Linn.f.).** Photosynthetica 34(1): 45-55.

Leaf gas exchange patterns in relation to leaf positions on stems were studied in field grown forest tree, teak during first year growth under intensive culture plantation. Net photosynthetic rates were low in immature leaves, increased basipetally on shoot. High photosynthetic rate found in fully expanded young leaves was associated with increased dark respiration rate and high radiation saturation as well as compensating irradiance for photosynthetic rate when compared to those of aged leaves. An increase in mesophyll limitations or decrease in carboxylation efficiency could explain gradual reduction in photosynthetic potential with leaf age after maturation in teak.

0653 Rajendrudu, G; Naidu, C.V; Mallikarjuna, K. 1999. **Effect of water stress on photosynthesis and growth in two teak phenotypes**. Photosynthetica 36(4): 627-630.

Two teak phenotypes differing in their leaf length/breadth ratios were subjected to water stress by withholding water supply for three weeks. Growth rates of whole plants, developing leaves and internodes were higher in the broad leaved phenotype than in the narrow leaved phenotype before and after imposing water stress treatment. The effect of water stress on these parameters was higher in the broad leaved phenotype than in the narrow leaved one. Photosynthetic rate, stomatal conductance and transpiration rate in both phenotypes were negatively affected by water stress and their decline under water stress was significantly higher in the broad leaved than narrow leaved plants.

0654 Rajendrudu, G; Naidu, C.V. 1999. **Induction of shoot growth in teak (*Tectona grandis* Linn.f.) during dormancy periods**. Indian Forester 125(3): 293-300.

This paper gives a brief review of the regulation of shoot growth in woody plants by internal and environmental factors, and then discusses the possibilities for inducing shoot growth during teak dormancy periods in commercial plantations. Such a mechanism could also be used for expanding forestry and agroforestry practices using teak in India.

0655 Singh, G.J.R. 1960. **Peculiar phenological behaviour of teak in South Madras**. Indian Forester 86(8): p488.

Reports of a local strain of teak in the Ramnad and Tirunelveli districts, which differs morphologically from other forms and flowers and fruits at different seasons from Nilambur or South Coimbatore teak. It reaches 20 ft. in height and 6 in. d.b.h. Coppice shoots grow readily and reach this height in 4-5 years, but then stagnate. A good return is gained by clear felling the pure stands every 6-10 years, and marketing the poles.

0656 Singh, K.P; Srivastava, S.K. 1986. **Seasonal variation in the biomass and non-structural carbohydrate content of fine roots of teak (*Tectona grandis* Linn.f.) plantations in a dry tropical region.** Tree Physiology 1(1): 31-36.

Roots were collected monthly for one year from plantations in the Varanasi Forest Division, Uttar Pradesh. Total non-structural carbohydrate content (TNC) of fine roots was highest during the dry summer and lowest in the early part of the rainy season. Seasonal trends in fine root biomass were opposite to those in TNC, with minimum in May and maximum in September. TNC content of roots increased with diameter and decreased with soil depth, and was about 12 percent higher in the 19-yr-old than in the 29-yr-old plantation.

0657 Siripatanadilok, S. 1973. **The development of flower in teak (*Tectona grandis* Linn. f.)**. (Thai). Thesis: 68p. Kasetsart University, Bangkok.

0658 Siripatanadilok, S. 1974. **Development of teak flower (*Tectona grandis* Linn.f.)**. (Thai). Forest Research Bulletin, Faculty of Forestry, Kasetsart University, Thailand 31: 71p.

A description of flower development during the 40 days from the formation of inflorescence primordia to fruit maturation.

0659 Srivastava, S.K; Singh, K.P; Upadhyay, R.S. 1986. **Fine root growth dynamics in teak (*Tectona grandis* Linn.f.)**. Canadian Journal of Forest Research 16(6): 1360-1364.

Seasonal variations in the standing crop (live and dead) of fine roots, and below ground net production and turnover were studied in a 19-yr-old teak plantation in the Varanasi Forest Division, Uttar Pradesh. Total root mass increased rapidly during the rainy season, reached a peak in September, then gradually declined to minimum in May except for a minor peak in February. Maximum teak root biomass occurred at 10-20 cm depth. Annual mean fine root biomass was 5420 kg/ha and annual net production was 5460 kg/ha.

0660 Sunitibala, Y; Gupta, S; Mukherjee, B.B. 1998. **Effect of sucrose on growth and chlorophyll synthesis of teak shoots in mixotrophic culture**. Journal of Plant Biochemistry and Biotechnology 7(1): 57-59.

Clonally propagated shoots of teak were cultured in vitro under photomixotrophic and photoautotrophic conditions in MS medium containing kinetin and benzylaminopurine. Sucrose concentrations were gradually depleted in mixotrophic cultures. In sucrose-free medium, shoot growth and chlorophyll synthesis in leaves decreased after 2-3 subcultures, whereas they were stimulated under photomixotrophic conditions with 10-30 g sucrose.

0661 Sutarja, D.S. 1977. **Correlation between water balance with radial growth in *Tectona grandis* Linn.f., *Shorea selanica* Bl and *Pinus merkusii* Jungh. et de Vriese. (Indonesian).** Buletin Berita Ikatan Alumni Fakultas Kehutanan Institut Pertanian Bogor 1-2: 16-19 .

0662 Thit, A.T. 1921. **Flowering of teak**. Indian Forester 47(8): p350.

A teak tree 23" in height and 2.5" in girth is observed to bear both flowers and fruits.

Go top

Go top

Plant Embryology

0663 Dabral, S.L. 1977. **Polyembryony in teak**. Indian Forester 103(10): 694-695.

A note reporting 0.5 percent incidence of polyembryony in germination tests on teak.

0664 Gunaga, R.P; Nagesh Prabhu, H; Surendran, T. 2004. **Variation in cotyledon number and phyllotaxy in seedlings of teak (*Tectona grandis* Linn.f.)**. Indian Forester 130(2): 235-236.

0665 Niranjan, P. 1950. **Studies on the embryogeny of some verbenaceae**. Journal of the Indian Botanical Society 30: p59.

0666 Pal, N. 1951. **Studies in the embryology of some Verbenaceae**. Journal of Indian Botanical Society 30: 59-74.

The paper describes the development of the flower and female gametophyte in teak and other two species and development of endosperm in *Tectona grandis*.

Go top

Plant Morphology, Anatomy and Histology

(See also 0900, 2586)

0667 **Bending of wood and bamboos**. Forest Research in India Part I 1951-52, 1952: p64.

Tests showed that teak wood is a poor-bender.

0668 Adarsh Kumar. 1973. **Studies on seedling evaluation of teak**. Forestry conference (Silvicultural Conference) 6-10 December 1973, 66. Forest Research Institute, Dehra Dun.

The work on seedling evaluation of teak has been reported in this paper. Various morphological characters associated with normal and abnormal seedlings have been described. On the basis of results obtained 9 categories of abnormal seedlings have been indicated.

0669 Baden-Powell, B.H. 1879. **A teak tree with alternate leaves**. Indian Forester 5: p328.

0670 Bagchi, S.K. 1999. **Correlations of age element in *Tectona grandis***. Indian Forester 125(5): 522-525.

Measurements were made of five characteristics total and bole height, diameter and girth at breast height, and crown length in 80 sets of teak trees. Each set contained 6 phenotypically superior trees from different locations in plantations in Tamil Nadu, Kerala and Karnataka. An analysis was made of correlation coefficients between pairs of characters with age as a separate character and without age. The results showed that age need not be considered for analytical purposes.

0671 Barcenas, A; Salazar, R. 2000 . **Phenology of important forest species in Honduras**. (Spanish). II Simposio sobre avances en la produccion de semillas forestales en America Latina: Memorias, Santo Domingo, Republica Dominicana, 18-22 de octubre 1999: 25-28. Centro Agronomico Tropical de Investigacion y Ensenanza, Turrialba, Costa Rica.

Phenological data are presented for different species including *Tectona grandis*.

0672 Beekman, H. 1917. **An anatomical investigation of annual ring development in *Tectona grandis***. (Indonesian). Tectona 10: 320-328.

0673 Bhat, K.M. 1998. **Cambial activity and juvenile wood formation in teak**. KFRI Research Report 137: 41p. Kerala Forest Research Institute, Peechi.

Determined the growth periodicity and factors influencing it during juvenile wood production, including false ring formation, the age at which teak stops producing juvenile wood and begin to form mature wood, and evaluated the differences in size and proportion of different secondary xylem elements, microfibrillar angle, specific gravity and bending strength between juvenile and mature wood.

0674 Bisset, I.J.W; Dadswell, H.E.Y; Amos, G.L. 1950. **Changes in fibre length within one growth ring of certain Angiosperms**. Nature 165(4192): 348-349.

A preliminary survey is made on fibre length variation within one growth zone of some timbers including teak and the results are tabulated.

0675 Brascamp, E.H.B. 1925. **Rings of teak trees in 1686, Uit het Kolonial Archief No. XLIII.p.822**. Tectona 15: 422-423.

0676 Cardoso, N.da S. 1991. **Characterisation of the wood anatomical structure, phenology and relations with the cambial activity of teak trees (*Tectona grandis* Linn.f.), verbenaceae.** Piracicaba, SP (Brazil): 133p.

0677 Chacko, K.C; Kedharnath, S; John, C.H. 2000. **Incidence of phyllotaxy variants in teak (*Tectona grandis* Linn.f.)**. Indian Forester 126(3): 314-316.

The occurrence of three types of phyllotaxy is reported in an experimental plantation raised using stumps in Kerala. Of 4509 plants observed for 25 months from sprouting, normal opposite decussate phyllotaxy was exhibited by 99.33 percent, whorled phyllotaxy by 0.60 percent and alternate phyllotaxy by 0.07 percent.

0678 Chowdhury, K.A; Rao, K.R. 1949. **The formation of growth rings in Indian trees part iv. False growth rings in saplings of teak (*Tectona grandis*) and Mahogany (*Switenia macrophylla*)**. Indian Forest Records (n.s.) Wood Technology 1(1): 15p.

Usually teak saplings produce incomplete or discontinuous false growth rings. The anatomical structure of the false rings has been studied in details and is recorded here. In rare cases, teak saplings may produce complete but false growth marks, which are anatomically similar to the true growth marks.

0679 Classen, J.C van R. 1908. **Rings of teak**. (Indonesian; English). Tectona 1/2: 125p.

0680 Coster, C. 1926. **A curious growing together of two teak stems**. (Indonesian; English). Tectona 19: 170-171.

The cause of growing together of two stems might be due to falling of one stem in the fork of another. At the place of contact the bark of both trees dried off and wound tissue was formed bringing the two limbs together. Consequently the flow of the sap of one of the stems was altered, causing the growth to be altered.

0681 D'Almeida, J.F.R; Desai, J.L. 1942. **A contribution to the study of the ecology foliar anatomy of Indian plants**. Journal of University, Bombay (Sci. No.) 10(5): 1-58.

A study was made of the anatomical features of the leaves of some Indian plants from Salsette, a typical monsoon region, with reference to the effect of environment on leaf anatomy. Descriptions of the leaf anatomy of various plants are preceded by notes on the general character of the species under review. The tree species dealt with including *Tectona grandis*.

0682 Fernandez, E.E. 1879. **Rings in teak wood; are they necessarily annual**. Indian Forester 4(4): 355-358.

0683 Geiger, F. 1915. **Anatomical investigations of annual ring development in *Tectona grandis***. Jahrbuch Fur wissenschafiche Botanik 55.

0684 Grace, J; Okali, D.U.U; Fasehun, F.E. 1982. **Stomatal conductance of two tropical trees during the wet season in Nigeria**. Journal of Applied Ecology 19(2): 659-670.

Measurements of stomatal conductance were made on teak and *Gmelina arborea* during the wet season in Nigeria. Stomatal conductance was mainly determined by the quantum flux. Transpiration rates were calculated from the stomatal conductances, using the Penman-Monteith equation. The rates were high and imply that almost all the net radiation was used to evaporate water.

0685 Griffith, A.L. 1946. **The stomates and early growth of some timber trees of the Malabar Coast**. Indian Forest Records (n.s.) Silviculture 6(2): 62-92.

Describes a series of investigations on the leaves and their stomates and the early growth of some of the principal timber trees including *Tectona grandis* of the Malabar coast of India. Some of the main conclusions drawn from the investigations are described.

0686 Gunaga, R.P; Surendran, T. 2002. **Leaf morphological variations in teak (*Tectona grandis* Linn.f.) clones.** Evergreen 48: 8-9.

The leaf morphological features of 9 month old clonal plants belonging to 15 different clones of teak established at the Central nursery in Chettikkulam, Kerala are tabulated. Results indicate that there exists considerable phenotypic variation between plus trees of teak.

0687 Hooper, E.D.M. 1880. **On a teak tree with alternate leaves**. Indian Forester 5: p328.

A curio teak with alternate leaves grown in Telenkheri gardens at Nagpore from Malabar seed origin of 1877.

0688 Jacoby, G.C Jr; D'Arrigo, R.D. 1990. **Teak (*Tectona grandis* Linn.f.), a tropical species of large-scale dendroclimatic potential**. Dendrochronologia 8: 83-98.

A 400-year tree growth ring width time series of teak from central Java is examined, focusing on radial growth responses of teak to climate. Comparison of the series with rainfall data indicated the importance of the dry and transitional seasons on radial growth. There was correspondence between climatic responses of Java teak and data for teak in India. Both chronologies exhibited positive correlations with rainfall during the transitional months between the wet and dry seasons of the monsoon. The potential value of dendrochronological studies in tropical regions is discussed.

0689 Jaijing, D. 1994. **Variation on certain morphological characteristics and annual ring growth of *Tectona grandis* Linn.f.** Kasetsart University, Bangkok: 125 leaves.

0690 Joshi, M.D; Kelkar, S.P. 1971. **Germination of seed in dry teak (*Tectona grandis* Linn.f.). (1) Preliminary studies in fruit development and seed dormancy.** Indian Forester 97(4): 210-215.

Studies were made on the anatomy of the fruit and the viability of seeds of teak from the Khapa range, Nagpur Division. Usually only one seed was fully developed in each quadrilocular fruit. It is suggested that inhibition of apparently developed seed may be caused by a restriction of the O_2 supply to the seed during development, possibly by lignin deposition in the fruit. The nature of the tubular structures and scope for further studies are discussed.

0691 Kedharnath, S. 1963. **Phyllotaxy variants in teak**. Indian Forester 89(2): p125.

The paper describes two unusual phyllotaxy variants of teak, one with alternate leaves and the other with whorls of three leaves at every mode.

0692 Kjaer, E.D; Kajornsrichon, S; Lauridsen, E.B. 1999. **Heartwood, calcium and silica content in five provenances of teak (*Tectona grandis* Linn.f.)**. Silvae Genetica 48(1): 1-3.

Heartwood percent and content of silica and calcium were estimated in a 17 year old provenance trial of teak at St. Croix, Virgin Islands. Average contents of silica was significantly different between provenances ranging from 0.27 to 0.66 percent. Percentage of heartwood and content of calcium were also significantly different between provenances and significantly correlated to tree size. Large trees had the highest heartwood percentage, but the lowest calcium content.

0693 Krishnaswamy, V.S; Mathauda, G.S. 1954. **Phenological behaviour of a forest species at New Forest, Dehra Dun**. Indian Forester 80(3): 124-153.

An investigation of the phenological behaviour of some tree species including teak growing at Dehra Dun was made. The characters investigated were renewal of leaves, leaf fall, deciduous or evergreen habit, and availability of ripe fruit or seeds.

0694 Manning, D.E.B. 1931. **Abnormal teak plant**. Indian Forester 57(11): p579.

Illustrates two plants from Yanaungmyin reserve, Pyinmana Division. In one, leaves are alternate instead of opposite as far as first branch, below which leaf scars show leaves are normal and opposite after forking each side has alternate leaves. Abnormal leaves have two central veins instead of one, while all the alternate leaves are not of this type.

0695 Osundina, M.A; Osonubi, O. 1989. **Adventitious roots, leaf abscission and nutrient status of flooded Gmelina and Tectona seedlings**. Tree Physiology 5(4): 473-483.

The possibility that adventitious roots alleviate mineral deficiency, limit accumulations of toxic minerals or delay leaf abscission in flooded plants, was investigated in a greenhouse study using *Gmelina arborea* and *Tectona grandis*.

0696 Pande, J.K. 1933. **Branching of teak in plantations**. Indian Forester 59(6): 345-347.

The tendency of teak plantations for forking and development of branches is described, occurring both in pure and bamboo mixed plantations. Forking observed even in single stems has persistent thick lower branches is attributed to light frost attacking leading shoot or drought affecting circulation of sap, which will reduce rate of vigour and growth of main stem. Author advocates judicious pruning of forked stems and thick persistent branches.

0697 Pande, J.K. 1934. **Forking of teak plants**. Indian Forester 60(5): p374.

The author does not agree forking due to grazing or browsing as it is observed in an effectively protected plantation also. He attributes damage to tops to frost and advocates against creating large clear fellings and leaving adequate standards to break up the frost level.

0698 Rajput, K.S; Rao, K.S. 1997. **Occurrence of sieve elements in phloem rays**. IAWA Journal 18(2): 197-201.

Solitary sieve elements or groups of sieve elements were encountered in the rays of secondary phloem of *Erythrina indica, Guazuma tomentosa, Acacia nilotica*, *Azadirachta indica* and *Tectona grandis* trees. These elements were short and possessed simple and compound sieve plates on their transverse to slightly oblique end walls. The detailed structure and possible significance of these elements are discussed.

0699 Rao, K.S; Dave, Y.S. 1981. **Seasonal variation in the cambial anatomy of teak**. Nordic Journal of Botany 1: 535-542.

0700 Rao, V.S. 1952. **The floral anatomy of some Verbenaceae with special reference to the Gynoecium**. Journal of Indian Botanical Society 31(4): 297-315.

The vascular anatomy of thirteen species of Verbenaceae is studied with the view of determining the inter relationships and evolutionary trends within the family. There are reductions in the calyx, androecium and gynoecium. On grounds of floral anatomy the species studied are classified into primitive and evolved.

0701 Rios R, C.A. 1979. **Generalities macroscopic and microscopic description of teak (*Tectona grandis* Linn.f.)**. (Spanish). Universidad Nacional de Colombia, Medellin (Colombia): 50p.

0702 Rutten, L. 1911. **Abnormal leaf in teak**. Tectona 4: 242-243.

0703 Sankar, S.J; Wahid, P.A; Kamalam, N.V. 1988. **Absorption of soil-applied radiophosphorus by black pepper vine and support tree in relation to their root activities**. Journal of Plantation Crops 16(2): 73-87.

Root activity patterns of *Piper nigrum* vines trailed on *Erythrina* standards and on teak poles were compared in field experiments employing a 32P soil-injection technique. In both cases, over 90 percent of the root activity was found within a 30 cm radius around the vine. The root activity of vines trailed on teak poles was more at 40 cm than in the upper soil layers. Vines trailed on teak poles absorbed more 32P than vines trailed on *Erythrina* standards.

0704 Shah, J.J; Unnikrishnan, K. 1969. **Bud trace connections in *Tectona grandis* Linn.f.** Current Science 38(12): 298-299.

Describes and illustrates diagrammatically the peculiar features of the vascular system of the bud, node and internode in teak.

0705 Singh, K.P; Srivastava, S.K. 1984. **Spatial distribution of fine root mass in young trees (*Tectona grandis*) of varying girth sizes.** Pedobiologia 27(3): 161-170.

Lateral and vertical distributions of fine root mass was studied in teak trees of 5 to 40 cm girths. Sampling was done in peak growing season at three distances from the tree base down to 40 cm depth. The composite root mass was separated into live teak roots, teak root necromass, herb root mass and soil organic matter. The amount of root mass distinctly varied with tree girth, sampling distance and soil depth.

0706 Singh, P.K; Sivaji, V. 2001. **Emptiness and seededness in teak (*Tectona grandis* Linn. f.) fruits**. Journal of Research, Birsa Agricultural University 13(1): 113-115.

Teak fruits collected from three provenances were categorized into three classes: large fruits, medium fruits and small fruits. Fruits collected from each provenance were split and the number of seeds present in each chambers were counted. The percentage of empty fruits gradually increased with the decrease in fruit size in all the three provenances. Among the seeded fruits, the maximum number of fruits were the one-seeded in all the provenances and size classes.

0707 Soeters, K. 1911. **The teak plant with abnormal leaves**. Tectona 4: p835.

0708 Srimathi, R.A; Emmanuel, C.J.S.K. 1984. **A conjointed quadruplet teak seedling**. Myforest 20(4): p245.

A brief description is given of a quadruplet seedling raised during seedling production for a provenance trial. The seedling had a single slender root system, 4 stems and different numbers, sizes and shapes of leaves and cotyledonary leaves on the different stems. Two of the seedlings in the quadruplet were well grown and the others average and poor.

0709 Suri, S.K. 1964. **Some foliage measurements of *Tectona grandis* (teak)**. Indian Forester 90(8): 529-534.

A study was made of the shape and size of leaves from a single tree, and of the numbers and fresh weights of leaves on nine trees. Foliage varied from sixty leaves weighing 0.7 kg. on a sapling of 3.2 in. g.b.h. to 3830 (41.7 kg.) on a tree of 30.5 in. g.b.h. A regression equation for leaf area based on length and width is presented.

0710 Vakshasya, R.K; Emmanuel, C.J.S.K. 1984. **An abnormal seedling in teak**. Indian Forester 110(5): 497-498.

A single deviant seedling was observed when a seed lot from Nilambur was germinated. A white patch, indicating chlorophyll deficiency, was noted on one cotyledon and on one of each of the first eight pairs of leaves. The potential use of such features as genetic markers is discussed.

0711 Venkateswaran, S. 1939. **Teak abnormality**. Indian Forester 65(1): 36-38.

An abnormal phyllotaxy of leaves was observed in coppice shoots coming from thinned shoots, and is attributed to environmental factors rather than inheritance by seed origin.

0712 Venugopal, B; Krishnamurthy, K.V. 1994. **Seasonal pattern of cell division in the vascular cambium of some tropical timber trees**. Cytologia 59(3): 323-332.

Studies were carried out on 3- to 5-yr-old stem twigs collected every two weeks for two years, for some tropical trees including *Tectona grandis* and the results are presented.

0713 Venugopal, N; Krishnamurthy, K.V. 1988. **Occurrence of multinucleate cambial initials in some tropical trees**. Current Science 57(21): 1174-1175.

A description of nuclear behaviour and the occurrence of multinucleate cells in the cambial initials of four deciduous trees including *Tectona grandis* and two evergreen species is given.

0714 Versluis, W. 1922. **A teak tree with lobed leaves**. (Dutch; English). Tectona 15: 263-264.

The author describes a case of *Tectona grandis* Linn.f. with lobed leaves instead of the usual entire edged ones.

0715 Wangcharoen, K. 1964. **Correlation between leaf weight and age of teak**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Leaf weight at the age of 10-20 years is significantly correlated to age, and correlation factor r=0.85 and regression equation Y=1.3384=0.485x.

0716 Whitehead, D; Okali, D.U.U; Fasehun, F.E. 1981. **Stomatal response to environmental variables in two tropical forest species during the dry season in Nigeria**. Journal of Applied Ecology 18(2): 571-587.

Measurements were made of stomatal conductance of *Gmelina arborea* and *Tectona grandis*. Stomatal conductance increased rapidly in the early morning and decreased after midday in both species but values in *G. arborea* were less than those in *T. grandis*. Leaf water potential was lower in Gmelina than in teak. Stomatal conductance in both species was mainly controlled by irradiance and air saturation deficit.

Go top

Dendroclimatology

0717 Berlage, H.P.(Jr). 1931. **The relationship between thickness of year-rings and rainfall in teak forests in Java**. (Indonesian). Tectona 24: 939-953.

0718 Bhattacharya, A; Yadav, R.R. 1999. **Climatic reconstructions using tree-ring data from tropical and temperate regions of India - a review**. Dendrochronology in Monsoon Asia. Proceedings of a workshop on Southeast Asian Dendrochronology, Chiang Mai, Thailand, 16-20 February 1998. D. Eckstein; P. Baas, Eds. IAWA Journal 20(3): 311-316.

Tree ring studies have been used in the tropical and Himalayan region in India to develop millennium-long climatic reconstructions. Several tropical trees in India produce annual growth rings due to a distinct seasonality in moisture supply. Some of these species like teak have datable growth rings and are useful in understanding the long-term monsoon variability in India.

0719 Catinot, R. 1970. **Preliminary thoughts on a possible physiological explanation of the annual growth rhythms of trees in the African tropical forest**. Bois et Forests des Tropiques 131: 3-36.

Explained the correlations between the annual growth rhythms of trees and the factors: day-length, duration of exposure to sunshine and the quantity of energy received, rainfall, temperature and atmospheric moisture saturation deficit.

0720 Champion, H.G. 1934. **Seasonal progress of height growth in trees**. Indian Forest Bulletin 88.

0721 Devall, M.S; Parresol, B.R. 2003. **A dendrochronological study of teak (*Tectona grandis* Linn.f.) in Puerto Rico**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

A dendrochronological study of the species has been made to investigate patterns of growth and to determine the effect of climate on the growth of teak and compared the growth of teak with that of *Hibiscus elatus*. It is found that teak growth is better than that of *Hibiscus*.

0722 Fujiwara, T; Pant, G.B; Kumar, K.R; Borgaonkar, H.P; Sickder, A.B. 2002. **Dendroclimatic response of ring-width chronologies of teak from eight sites in Central India**. IAWA Journal 23(4): p463.

0723 Murphy, J.O. 1994. **A dendroclimatic study of teak from East Java**. Proceedings of the Koninklijke Nederlands Akademie van Wetenschappen. Biological, Chemical, Geological, Physical and Medical Sciences 97(2): 183-199.

A dendroclimatic investigation has been made into an extended teak tree ring-index chronology from East Java. Significant correlations have been established between teak growth rates and precipitation, based on meteorological records up to 1960 from two locations in East Java. Growth correlated negatively with the number of dry months prior to the new growth season.

0724 Nobuchi, T; Janmahasatien, S; Sakai, M. 1996. **Seasonal changes of wood formation and some characteristics of heartwood formation in teak (*Tectona grandis* Linn.f.) plan-**

tation. Kasetsart Journal, Natural Sciences 30(2): 254-263.

Heartwood and sapwood formation and properties, anatomy and elemental analysis investigated in relation to season, topography, soil moisture content and seasonal changes in leaf area, in 22-yr-old plantation grown teak in a typical monsoon area in northern Thailand. Soil moisture content was higher in the rainy season, and leaf budding started at the beginning of the rainy season.

0725 Ohta, S. 1997. **High resolution of dendroanalysis on the environment and climate from tropical trees**. Tropical Forestry 39: 2-11.

Includes data on dendrochronological studies of wood including *Tectona grandis*.

0726 Palmer, J.G; Murphy, J.O. 1993. **An extended tree ring chronology (teak) from Java**. Proceedings of the Koninklijke Nederlands Akademie van Wetenschappen. Series C, Biological and Medical Sciences 96(1): 27-41.

A 416-yr chronology for *Tectona grandis* in Java, compiled in 1931, has been extended to 1989. Analysis of the chronology showed a dominant near-50-yr cycle in growth patterns.

0727 Priya, P.B; Bhat, K.M. 1998. **False ring formation in teak (*Tectona grandis* Linn.f.) and the influence of environmental factors.** Forest Ecology and Management 108(3): 215-222.

Seedling anatomy and cross sectional discs of 8- and 12-yr-old teak trees in plantations at Nilambur, Kerala were examined for growth ring analysis and determination of environmental factors responsible for false ring formation. The results showed that rainfall during dry periods, drought during the active growing season, polybag/field transplantation of seedlings and juvenility are the important causative factors of frequent false rings in teak. False ring formation in teak appears to be mainly a resultant feature of growth ring responses to different environmental and physical factors.

0728 Priya, P.B; Bhat, K.M. 1999. **Influence of rainfall, irrigation and age on the growth periodicity and wood structure in teak (*Tectona grandis*).** IAWA Journal 20(2): 181-192.

Growth periodicity was followed for two consecutive annual cycles to reveal the pattern of wood formation in plantation-grown teak at three different localities in India. Rainfall and age were found the two factors that influenced cambial activity. Juvenile trees and those grown in relatively high rainfall areas had a prolonged cambial activity and retained foliage throughout the year. They produced wider rings with higher proportions of latewood.

0729 Pumijumnong, N. 1995. **Dendrochronology with teak (*Tectona grandis* Linn.f.) in northern Thailand**. Fachbereich biologie, Hamburg: 109p. Hamburg University, Germany.

0730 Pumijumnong, N. 1999. **Climate growth relationships of teak (*Tectona grandis* Linn.f.) from northern Thailand**. Tree ring analysis: Biological, methodological and environmental aspects: 155-168. R. Wimmer; R.E. Vetter, Eds. CABI Publishing, Wallingford.

0731 Pumijumnong, N; Park, W.K. 1998. **Reconstruction of Southeast Asian monsoon using anatomical variables and teak tree rings**. Abstracts of the Fourth Pacific Regional Wood Anatomy Conference, 'New horizons in wood anatomy on the threshold of a new millennium', 26-29 October, Kwangju, South Korea.

Anatomical characteristics of earlywood and latewood of teak growing in northern Thailand show high correlations with precipitation and temperature variables. The ring-width chronology shows only correlations with precipitation. A regression equation incorporating earlywood vessel diameter and ring-width chronologies was used to reconstruct May-July precipitation. Latewood vessel density was used to reconstruct April-May temperature. Stepwise multiple regression was employed for calibration and could be verified with independent data.

0732 Pumijumnong, N; Park, W.K. 1999. **Vessel chronologies from teak in northern Thailand and their climatic signal**. Dendrochronology in Monsoon Asia. Proceedings of a Workshop on Southeast Asian Dendrochronology, Chiang Mai, Thailand, 16-20 February 1998. D. Eckstein; P. Baas, Eds. IAWA Journal 20(3): 285-294.

Five teak trees in northern Thailand were selected for the study of vessels in terms of dendroclimatology. Investigations are made to understand how strongly the vessel characteristics related to climate and

how these relationships different from those of ring widths. All vessel parameters of the total ring and of the earlywood were negatively correlated with precipitation during the transitional period between the dry and the wet season. The latewood vessel parameters are negatively correlated with June temperature. The climatic signals of the vessel parameters and of the tree-ring width are different from each other.

0733 Rajput, K.S; Rao, K.S. 1998. **Seasonal anatomy of secondary phloem of teak (*Tectona grandis* Linn.f. Verbenaceae) growing in dry and moist deciduous forests.** Phyton Horn 38(2): 251-258.

The seasonal development of secondary phloem anatomy was studied in samples of bark collected from *Tectona grandis* growing in the moist and dry deciduous forests of Gujarat state. In both forest types active cambial cell division and differentiation of phloem began in June when the dormant shoot buds opened. In the moist deciduous forest, phloem developed more rapidly than xylem at the beginning of growth season. The structure and development of secondary phloem are discussed with other developmental phenomena occurring within the tree.

0734 Rao, K.S; Rajput, K.S. 1999. **Seasonal behaviour of vascular cambium in teak (*Tectona grandis*) growing in Moist Deciduous and Dry Deciduous Forests.** IAWA Journal 20(1): 85-93.

Seasonal behaviour of vascular cambium in *Tectona grandis* growing in Moist Deciduous Forests and Dry Deciduous Forests of Gujarat State in Western India was studied for one annual cycle. In both the forests active cambial cell division and simultaneous differentiation of xylem and phloem started in June when the dormant shoot buds opened. Maximum radial growth in trees of both forests occurred during the monsoon period. Phloem differentiation ceased before xylem differentiation in both the forests. During dry months and the leafless periods the cambium remained dormant. In both forests, the seasonal anatomical changes associated with the cambium closely followed the phenology of the tree and local climatic conditions.

0735 Ruengthanom, Q.S. 1961. **Correlation between teak growth and the quantity of rainfall in September and October (1950-59)**. (Thai). Student Thesis. Kasetsart University, Bangkok.

No relationship was observed between the quantity of rainfall and growth of teak during the period 1950-59 when observed in April-May 1960.

0736 Tomazello, M; Cardoso, N.da S. 1999. **Seasonal variations of the vascular cambium of teak (*Tectona grandis* Linn.f.) in Brazil**. Tree ring analysis: Biological, methodological and environmental aspects: 147-154. R. Wimmer; R.E. Vetter, Eds. CABI Publishing, Wallingford.

0737 Yadav, R.R; Bhatacharya, A. 1996. **Biological inferences from the growth climate relationship in teak from India**. Proceedings of the Indian National Science Academy. Part B Biological Sciences 62(3): 233-238.

Tree ring samples of teak collected from dry deciduous forest in Korzi, Andhra Pradesh, were analysed to work out its dendroclimatic potential - especially in the reconstruction of monsoon variability. A ring width chronology was developed from nine radii of five trees. The response function analysis carried out showed a strong direct relationship between growth and precipitation, indicating that teak chronologies could provide valuable data for understanding long-term monsoon variability in India.

Go top

Genetics and Breeding

(See also 1086)

0738 **National Seminar on Tree Improvement, 8 January 1981**. Tamil Nadu Agricultural University, Department of Forestry, Coimbatore, Tamil Nadu, 1981: 122p.

Twenty one papers were presented in the seminar held at Kumarapumal Farm Science Centre, Tiruchirapalli. An introductory paper gives a resume of tree improvement work in Tamil Nadu University and a paper on improvement of teak also included.

0739 Akinsanmi, F.A. 1976. **Variation in the growth characteristics of teak (*Tectona grandis* Linn.f.) in south-western Nigeria.** Nigerian Journal of Forestry 6(1/2): 12-14.

0740 Apichart Kaosa ard. 1993. **Teak breeding and propagation strategy in Thailand**. Proceedings of the Workshop on Production of Genetically Improved Planting Materials for

Afforestation Programmes, Coimbatore, 18-25 June 1993, 7-RAS/91/004: 67-75. K. Vivekanandan; K.N. Subramanian; N.Q. Zabala; K. Gurumurthy, Eds.

0741 Apichart Kaosa ard. 1996. **Domestication and breeding of teak (*Tectona grandis* Linn.f.)**. Forestry Department, Philippines, No. FAO-FO-RAS-91-004: 63p.

0742 Apichart Kaosa ard. 1999. **Teak (*Tectona grandis* Linn.f.): Domestication and breeding**. Teaknet Publication 5/1999: p86.

0743 Apichart Kaosa ard; Chanpaisaeng, S. 1992. **Teak breeding strategy in Thailand**. Proceedings of the Seminar on 50 Anniversary of Huay-Tak Teak plantation, Bangkok, 5-8 August 1992.

A tree improvement strategies is outlined for Thailand. Major constraints in tree improvement of teak are low seed production areas as well as in seed orchards and a low yield at seeding from available seed.

0744 Bagchi, S.K; Sharma, V.P; Gupta, P.K. 1989. **Developmental instability in leaves of *Tectona grandis***. Silvae Genetica 38(1): 1-6.

Developmental instability of *T. grandis* clones from Uttar Pradesh, Karnataka, West Bengal and Kerala and from Laos was studied in the top, middle and lower crown strata by asymmetry and 2 kinds of intraleaf variability of vein distribution. Instability varied among clones, trees and zones. Instabilities of leaf parts were positively and highly correlated with each other. Variation in the magnitude of different instability indices of various clones was seen as evidence of a common genetic mechanism.

0745 Bhat, K.M. 2001. **Breeding for improved wood quality of teak**. Genetics and Silviculture of teak: 147-163. A.K. Mandal; S.A. Ansari, Eds. International Book Distributors, Dehra Dun.

Teak breeding programmes should include improvement of growth rate, straightness, height and girth of the tree as well as wood structure and properties that dictate the timber quality criteria. Basic knowledge of wood property variations is a prerequisite for selection of desired traits in breeding. While the tree form has received considerable attention of teak breeders in the past, modification of basic wood structure and properties appears to be a new challenge. The paper focuses particular attention on the latter in reviewing the wood quality aspects while tree/bole form is discussed briefly.

0746 Brown, A.G; Palmberg, C.M (Eds). 1978. **Third World Consultation on Forest Tree Breeding. Session 3. Population improvement**. (French; English). CSIRO, Canberra: 475-748.

Five invited special papers included are on *Pinus taeda* and *P. elliottii* in the southern USA, *P. patula, P. elliottii* and *P. taeda* in southern Africa, *Tectona grandis*, eucalypts and *P. radiata* in Australasia.

0747 Brown, A.G; Palmberg, C.M (Eds). 1978. **Third World Consultation on Forest Tree Breeding. Session 1. Exploration, utilization and conservation of gene resources**. CSIRO, Canberra: 112p.

Four invited special papers on genetic conservation, and gene resources of tropical pines and teak, eucalypts and poplars and four voluntary papers are included.

0748 Bryndum, K. 1968. **Genetic research of teak**. Proceedings of the first Silvicultural Seminar, Royal Forest Department R.118: 10-17.

The improvement work on teak carried out at the Teak Improvement Centre at Ngao, Lampang are described under clonal tests, provenance trials, progeny tests and nursery research. The vegetative propagation methods were discussed in detail. The controlled pollination trials undertaken are described and problems encountered in isolation and emasculation are presented. The teak seed germination problems are also discussed.

0749 Chalmers, W.S. 1962. **The breeding of pine (*Pinus caribaea* Mor.) and teak (*Tectona grandis* Linn.f.) in Trinidad: Some early observations**. Eighth British Commonwealth Forestry Conference, East Africa, 1962: 10p. Government Printing Office, Trinidad.

Factors considered in the selection of teak and pine plus trees are outlined. Of several methods of vegetative propagation tried, budding is found better for teak. Clonal trials have been tried for both species to test the genotype of the selected plus trees. Plants are being raised from seed collected from open-pollinated plus trees for use in progeny trials.

0750 Champion, H.G. 1931. **Teak abnormalities**. Indian Forester 57(1): 103-107.

Seven abnormalities were observed in a plantation and the probable cause due to mutation is discussed. Illustrated abnormalities are (1) Cabbage form-its proportionate internode development, (2) leaves ternately

whorled (3) leaves normal but alternate and spirally arranged on a straight stem, (4) leaves normal but alternate and bifarous on a zig-zag stem, (5) leaves alternate appearing derived from fusion of two leaves, (6) leaves mostly normal but one or more pairs fused, and (7) leaves more or less divided.

0751 Champion, H.G. 1933. **The importance of seed origin in forestry**. Indian Forest Records (Silviculture Series) 16(5): 76p.

Information from all over the world is summarised. In the chapter on geographical races specially relevant to teak author remarked that teak occurs in a number of geographical races with well-defined characteristics in appearance and development, and Burma stock has grown up advantageous in several widely scattered places.

0752 Chuntanaparb, L. 1972. **Planning breeding programme for tropical hard wood**. Special study of Faculty of Forestry, 1972: 25p. Kasetsart University, Bangkok.

The importance of a tree breeding programme for tropical forestry has been pointed out. The guide lines for establishing and developing operational tree improvement programme based on modern plant breeding theory and practice have been presented. General considerations on choosing the species, securing immediate seed supplies, selecting of plus trees, establishing seed orchards, and long term research programmes have been reviewed, and discussed extensively. Planning operational breeding programmes for tropical hardwoods have been proposed using teak. Finally the importance of intra and international co-operation has been stressed.

0753 Coster, C; Eidmann, F.E. 1934. **Selection of teak (*Tectona grandis* Linn.f.)**. (Dutch; English). Tectona 27(1): 1-45.

The research comprises comparison of seed from 8 origins in British India, Burma, Siam, Indochina and 4 origins from Java and 3 from special Java and one from Moena (Celebes) Islands. The cultivation methods under taungya with *L. glauca* is described. The seed of different origins is described and weights are recorded. Germination problem and progress in research also outlined. Vegetative characteristics of different origins are discussed and laboratory germination tests involving suction force of seed, oxygen requirements of root system, transpiration of leaves etc, are also given.

0754 Coster, C; Hardjowasono, M.S. 1935. **Selection of teak (*Tectona grandis* Linn.f.) II. Growth during the second year**. Korte Meded Boschbouw Proefsta 49; Tectona 28(1): 3-21.

Gives details of growth of different teak varieties and height and diameter growth, form of bole, branching habit, leaf shedding etc. Thinning requirements are discussed and it is concluded Java teak is best and varieties from Siam, Indochina and Burma may be useful in places where Java teak tends to be branchy and subjected to wind damage, and as a protection against wind-Malabar teak is suggested.

0755 FAO. 1966. ***Tectona grandis* Linn.f. (Teak). Information from countries of origin**. FAO Secretariat, Rome.

Based on morphological characteristics, listed the geographical extent, ecologicial conditions, and distinguishable characters of nine seed origins from India. Information is also recorded for provenance trials and long-established plantations of exotic origin. The countries interested in new introductions or future provenance trials are listed.

0756 FAO. 1974. **Report on the FAO/DANIDA training course on forest tree development, Limuru, Kenya, 24 September-20 October 1973**. FAO Report FAO-DEN-TF 112: 344p.

Topics of principles of variation, selection and inheritance, the relations of heredity and environment, species and provenance trials, seed source classification, seed collection, handling and certification, individual selection, seed orchards, progeny trials, breeding for disease resistance, the economics and planning of tree improvement programmes and international programmes in forest gene resources are covered. Case histories are presented on *Pinus caribaea* and *Tectona grandis*.

0757 Forest Research Institute, Dehra Dun. 1934. **Summary of reports on the All-India teak seed origin investigation**. Proceedings of the 4th Silvicultural Conference, Dehra Dun.

0758 Forest Research Institute, Dehra Dun. 1951. **Research report: Plant breeding-Forest Research Institute and Colleges, Dehra Dun**. Agriculture Research, Indian Council of Agriculture Research 1: p1; 47-60; 152-158. Forest Research Institute, Dehra Dun.

The study of wood characters of teak in seedlings of different origins indicated variation within and between provenance groups.

Chromosome counts made in seedlings for North Burma showed 2n=36. Selfing and cross pollination studies are in progress.

0759 Forest Research Institute, Dehra Dun. 1954. **The importance of seed origin: Summary of results to date of the All India Co-operative teak seed origin investigation**. Proceedings of the 9th Silvicultural Conference, Dehra Dun. Forest Research Institute, Dehra Dun.

0760 Forest Research Institute, Dehra Dun. 1962. **Plant breeding research teak, Forest Research Institute and Colleges, New Forest, Dehra Dun**. Agriculture Research, Indian Council of Agriculture Research 2: 22-30; 166-173; 241-246. Forest Research Institute, Dehra Dun.

Plus trees of teak were selected for crossing. A study is being made of the variation in fibre length and specific gravity of wood of teak. Crosses between *Tectona hamiltoniana* and *Tectona grandis* were made.

0761 Gogate, M.G; Gujar, D; Mandal, A.K; Sharma, R; Lal, R.B; Gupta, B.N. 1997. **Genetic analysis of quantitative characters in teak: (*Tectona grandis*)**. Annals of Forestry 5(2): 165-167.

Progenies of 18 half-sib families of teak were evaluated for height, diameter and basal area over 8 years at Mohoghata Research Station, Maharashtra. Analysis of data revealed non-additive gene action for height and additive gene action for diameter and basal area. Moderate to moderately high estimates of heritability and genetic gain were obtained for diameter and basal area including highly significant genetic correlation for these two traits.

0762 Gram, K; Larsen, C.S. 1960**. The flowering of teak (*Tectona grandis*) in aspects of tree breeding, based on observations in Thailand.** FAO Teak Sub-Commission, New Delhi FAO/TSC-60/3.2, 1960: 4p.

Discusses the effect of flowering habit on the growth form of teak, individual differences in the length of the juvenile period and the possibility that these differences may be genetically conditioned.

0763 Gunaga, R.P; Vasudeva, R; Hanumantha, M; Swaminath, M.H. 2000. **Blooming variation among clones of different provenances in teak**. Myforest 35: 237-246.

A study was taken up to estimate the blooming synchrony among clones of teak seed orchard and to understand its implication to the fruit production.

0764 Hamzah, Z. 1977. **History of teak plant breeding**. (Indonesian). First Symposium on Breeding in Agriculture, Indonesia, 1977. Vol. 2: 22-36.

0765 Harahap, R.M.S. 1977. **Broad-sense heritability of some characters in teak**. (Indonesian). Laporan, Lembaga Penelitian Hasil Hutan 260: 12p.

0766 Hartono, W; Harahap, R.M.S; Suhendi; Alrasjid, H. 1978. **Tree breeding in Indonesia**. Third World Consultation on Forest Tree Breeding, Session 3, Population improvement: 707-715. A.G. Brown; C.M. Palmberg, Eds. CSIRO, Canberra, Australia.

A brief review of breeding programmes for teak is given along with other species .

0767 Hedegart, T. 1967. **Intensive breeding in forest trees with special reference to teak**. Proceedings of Seminar on Forest Seed and Tree Improvement in Thailand: 3p. Teak Improvement Centre, Nago, Thailand.

0768 Hedegart, T. 1967. **Variation and selection in forest tree with special reference to teak**. Proceedings of Seminar on Forest Seed and Tree Improvement in Thailand: 4p. Teak Improvement Centre, Nago, Thailand.

0769 Hedegart, T. 1971. **Teak forestry in Togo-consultancy report to FAO suggestions for improvement**. Thai-Danish Teak Improvement Centre, Ngao: 9p.

Teak has been planted under highly varying environmental conditions in Togo, since beginning of this century. Based on observations in these generally small and scattered plantation plots, suggestions concerning future teak forestry in Togo are summarised.

0770 Hedegart, T. 1972. **Teak (*Tectona grandis* Linn.f.): Breeding efforts in Thailand**. Teak Improvement Centre, Ngao, Thailand: 9p.

The history of teak forests and their exploitation in Thailand was traced and the breeding programmes carried out by Teak Improvement Centre since its inception under the heads (1) provenance research (2) selective breeding selection and seed orchards, selection and demarcation and management of seed source areas, progeny tests, flowering and pollination studies etc.) were discussed and described in detail.

0771 Hedegart, T. 1972. **The Thai-Danish Teak Improvement Centre-five years after initiation**. Vanasarn 30(1): p21.

Information includes silvicultural, nursery and laboratory research, and provenance research of teak. The chapter on breeding includes the selective breeding, vegetative propagation, clone collections, and seed-orchard work of Teak Improvement Centre. It also describes seed source areas, flowering and pollination studies, and finally silvicultural research, nursery and laboratory research, education of counterparts and adoption of other species of importance for investigations and report on Pine project.

0772 Kaushik, R.C. 1960. **Teli variety of *Tectona grandis***. Proceedings of the 9th Silvicultural Conference, Dehra Dun 1956 (Pt. II): 92-94.

Describes a new variety of teak first noted in a 1923 plantation raised in Kanara (Mysore State) but also since found scattered in the natural forest. Leafing, flowering and fruiting are all much earlier, growth is definitely faster and cleaner, and the wood is harder to work and oilier. Nursery experiments are in progress to test the heritability of these characters.

0773 Kedharnath, S. 1963. **Present status of forest tree breeding in India**. FAO, World Consultation of Forest Genetics and Tree Breeding, Stockholm Vol. II FAO/FORGEN 7/6.

Briefly reviews the work in progress on the breeding with teak, samul, red sanders, chir pine, wattles and eucalypts. The major effort is focused on the genetic improvement of teak. The chromosome number of teak is 2n-36. The breeding programme includes selection of plus trees and establishment of clonal seed orchards for important provenances of teak; selection of trees for resistance to the attack of leaf skeletoniser (*Hapalia machaeralis*); parent progeny testing of selected trees and controlled pollination between selected trees and also interspecific hybridisation between *Tectona grandis* and *T. hamiltoniana*.

0774 Kedharnath, S. 1967. **Genetics and forest tree breeding**. Proceedings of 11th Silvicultural Conference, Dehra Dun. Forest Research Institute, Dehra Dun.

Reports on tree improvement work concerning mainly teak, semal and chir pine with the objective of evolving improved strains with inherent vigour of growth, good form and other desired breeding characters. The work done on teak and chir pine during the last five years is reviewed. The report on teak covers the heads selection of plus trees, establishment of seed orchards, controlled pollination experiments and interspecific hybridization.

0775 Kedharnath, S. 1974. **Genetic improvement of forest tree species in India**. Breeding researches in Asia and Oceania. Proceedings of the Second General Congress of the Society for the Advancement of Breeding Researches in Asia and Oceania. Session VII. Breeding of tropical tree species: 367-374. Ramanujam, S; Iyer, R.D; Gupta, B.K, Eds. Indian Society of Genetics and Plant Breeding, New Delhi.

A brief review is given of the breeding work in India on *Tectona grandis*, *Pinus roxburghii*, *Bombax ceiba*, *Pterocarpus santalinus* and *Eucalyptus* species. Induced polyploidy and mutagenesis are very briefly considered in a number of genera.

0776 Kedharnath, S; Jaiswal, P.L; Wadhwani, A.M; Rajinder, S; Chhabra, N.N; Hallan, S (Eds). 1983. **Genetical research in India**. 358p. Indian Council of Agricultural Research, Publications and Information Division, New Delhi.

One of four volumes describing genetic and related research in India and published to mark the XV International Congress of Genetics held at New Delhi on December 12-21, 1983. There is one paper of forestry interest: Kedharnath, S. Genetics and forest-tree breeding. 18-190. Tree breeding strategies employed in India include the exploitation of natural variation and the testing of hybrids. Work on teak, *Bombax ceiba*, eucalypts and chir pine is described briefly.

0777 Kedharnath, S; Raizada, M.B. 1961. **Genetics and forest tree breeding**. Proceedings of 10th Silvicultural Conference, Dehra Dun, 1961 Part II: 203-214.

Reviews the work on teak genetic improvement currently being carried out in the forest genetics section of the Forest Research Institute at Dehra Dun. Chromosome number of teak has been determined. Grafting and budding has been successfully done in teak.

0778 Kerbert, H.J. 1908. **On the origin of teak forests**. Tectona 1: 580-585.

0779 Kertadikara, A.W.S; Prat, D. 1995. **Isozyme variation among teak (*Tectona grandis* Linn.f.) provenances**. Theoretical and Applied Genetics 90(6): 803-810.

Fourteen isoenzyme systems were analysed in leaf parenchyma of nine native and introduced populations of teak from Thailand, Java, Ivory Coast and Tanzania. These enzyme systems were encoded by 20 putative loci of which 18 were polymorphic. Populations showed a general lack of heterozygosity. The cluster analysis showed two main gene pools, the first consisted of the Indian provenances and the second of African, Indonesian and Thai provenances.

0780 Kertadikara, A.W.S; Prat, D. 1995. **Genetic structure and mating system in teak (*Tectona grandis* Linn.f.) provenances**. Silvae Genetica 44(2/3): 104-110.

Genetic variability in teak has been previously analysed quite exclusively in provenance or progeny tests using quantitative traits. Few data were available on genetic diversity revealed by genetic markers. Isoenzyme banding patterns in 14 enzyme systems was assessed using leaf tissue of seedlings from 9 populations, including 1 population which consisted of 10 open-pollinated progenies, from India, Indonesia, Thailand, Cote d'Ivoire and Tanzania.

0781 Kjaer, E.D; Siegismund, H.R; Suangtho, V. 1996. **A multivariate study on genetic variation in teak (*Tectona grandis* (L.))**. Silvae Genetica 45(5/6): 361-368.

Genetic differentiation between populations of teak was examined in nine quantitative characters and ten allozyme loci. Large differences between populations were revealed in the quantitative traits. Regional patterns were revealed by multivariate analysis of the data, but there were also substantial variation within ecological-geographical defined regions. Differentiation between provenances from Laos was less than the variation within Thailand, West India and Indonesia. A much less pronounced differentiation between populations was found in allozyme markers. The fixation index was only 4 percent, and no clear geographical pattern was found in the allozyme data.

0782 Kumaravelu, G. 1979. **Clonal identification of *Tectona grandis* by isoenzyme studies**. Indian Forester 105(10): 716-719.

Four clones of teak were analysed biochemically for the esterase isoenzyme and the results indicate that it is possible to identify individual clones by this method.

0783 Lakshmikantham, D; Rawat, M.S; Kedharnath, S. 1974. **Half-sib analysis of genetic variance in teak**. Breeding researches in Asia and Oceania. Proceedings of the Second General Congress of the Society for the Advancement of Breeding Researches in Asia and Oceania. Session VII. Breeding of tropical tree species: 413-418. Indian Society of Genetics and Plant Breeding, New Delhi.

Heritability estimates for height in 16 half-sib families were 88, 85, 76 and 69 percent at 2, 4, 6 and 8 years, respectively, while those for stem girth were 88, 73, 74 and 53 percent respectively. Stem diameter and height were highly and positively correlated over the period. Prediction of family performance at 9 years was shown to be valid when based on correlation data of height and stem diameter with age at 6 years.

0784 Lane, D.A. 1970. **Reforestation and forest improvement in Thailand**. Vanasarn 28(3): 15-34.

The paper at the end contains the details of teak planted from 1910 to 1969. Early planting of teak were limited to only a few hundred acres which was increased as below with experience gained, 1951-53 (1000-1500 acres), 1954-60 (2000 to 5000 Acs.) and 1961-1969 (5000 to 20,000 acres). Totally during the period 1910-1969, 1,12,130 acres of teak is planted.

0785 Larsen, C.S. 1966. **Genetics in teak (*Tectona grandis* Linn.f.)**. Arsskrift Veterinary and Agriculture High School, Kobenhavn: 234-245.

Discusses work on teak breeding in Thailand, in particular the differences between two clones in the age of first flowering which determines the length of the straight unforked stem.

0786 Laurie, M.V. 1935. **Seed origin and its importance in Indian forestry**. Indian Forester 62(1): 18-22.

Investigation is made to know the effect of the teak seed origin on its growth.

0787 Laurie, M.V. 1939. **The importance of seed origin**. Proceedings of the 5th Silvicultural Conference, Dehra Dun, 1939, Item 4: 103-109. Forest Research Institute, Dehra Dun.

Details are given of the characteristics of 24 species of Indian trees including teak exhibiting individual and racial variations in the timber growth, form, hardness, yield of oil, resin or other minor products etc., many of these variations being of commercial importance.

0788 Laurie, M.V. 1939. **The importance of origin of seed in forestry**. Indian Forester 65(3): 145-150.

All India cooperative teak seed origin studies in progress aim at (i) seed germination (ii) rate of early growth (iii) volume production per acre (iv) timber form (v) suitability for growth in localities outside their natural range etc. The author suggests carrying out investigations (a) existence of figured wood and its inheritance (b) teak coloured wood (c) inheritance of fluting and (d) inheritance of relative frost hardness in some origins observed.

0789 Mandal, A.K; Chawhaan, P.H. 2003. **Investigations on inheritance of growth and wood properties and their interrelationships in teak**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

An investigation was undertaken to (i) assess the extent of genetic variation for growth and wood characters, (ii) estimate narrow sense heritability and genetic gain and (iii) identify best general combiners. Data on growth of height, dbh, basal area and wood specific gravity, sap wood and heart wood percent were collected and subjected to analysis of variance followed by estimation of genetic parameters. Results indicated that growth and wood characters are strongly inherited and most of the traits are under the influence of additive gene action indicating scope for improvement through selection and sexual reproduction.

0790 Mathews, J.D. 1961. **A progress of forest genetics and forest tree breeding research**. Report to the Government of India under FAO-Expanded Technical Assistance Program FAO-ETAP Report 1349.

A long term breeding programme for teak in India has been prepared, with suggestions for selection and breeding of teak under the heads, selection of plus trees and seed orchards, vegetative propagation, flowering, plant pollination, progeny testing, orchard for seed production and breeding system.

0791 Melchior, G.H. 1969. **The genetic improvement of tropical forest trees and its application to forest management**. (Spanish). Revista Forestal Venezolana 12(18): 23-51.

Reviews methods used in species and provenance trials, and gives some data from trials undertaken by the Forestry Institute of the University of Los Andes, Venezuela. *Pinus caribaea* and *Tectona grandis* are among species growing well on warm sites.

0792 Mooksombat, S. 1964. **Teak chromosome**. (Thai). Student Thesis. Kasetsart University, Bangkok.

A study of chromosomes from teak flower buds in diakinesis stage of macrosporophytes reported 18 pairs or 2n=36 chromosomes.

0793 Nagarajan, B; Gireesan, K; Venkatasubramanian, N; Shanthi, A; Sharma, R; Mandal, A.K. 1996. **An early evaluation of gene action in teak**. Myforest 32: 136-139.

0794 Prawotosoedarmo, S. 1957. **Investigation of races within species *Tectona grandis* Linn.f., in relation to decorative properties, growth etc. for breeding proposed in Indonesia.** 2nd Session of FAO Teak Sub-Commission, Bandung FAO/TSC-57/25: 3p. FAO, Rome.

Discusses various forms distinguished by timber or stem characters and views as to which of them may be considered true varieties, and recapitulate briefly on Coster and Eldmann's provenance trials. Javanese and Malabar teak appear to be superior in height, diameter growth and stem form.

0795 Rao, H.S. 1959. **Problems in Indian forest plant breeding**. Indian Forester 85(9): 515-527.

Many problems of forest plant breeding in India are discussed and different methods of genetic improvement programmes to be adopted are suggested. An inventory of mother trees for seed should be made all over the country for all species, and progenies raised from them and tested. Progenies of recorded `giant trees' should be raised to evaluate the genotype of these moribund old individuals. Important forest plant breeding problems of India include improvement of *Tectona grandis* and other species.

0796 Rawat, M.S. 1994. **Fruit/seed setting in teak (*Tectona grandis* Linn.f.): A point to ponder.** Indian Forester 120(12): 1076-1079.

The reasons for low seed production in teak are discussed, based on observations made from trees, progenies and grafts from 1926 to 1928 and from the seed orchard and the germplasm bank established as part of the teak improvement programme started in 1960 at the Forest Research Institute, Dehra Dun, Uttar Pradesh. The observations cover: flowering date and period; numbers and size of inflorescences; flower morphology; pollen development; fertilization; fruit production; germination, growth and winter survival of offspring; fruit setting and provenance performance.

0797 Richens, R.H. 1945. **Forest tree breeding and genetics**. Joint Publication Imperial Agricultural Bulletin, Burma 8: 79p.

This bulletin collates the more important papers on this subject that have appeared since 1930. General principles of tree breeding are described in an introductory section with a brief account of the basic theoretical concepts. The methods so far used include line breeding, the development of hybrids exhibiting heterosis, and the utilization of polyploids. The selection criteria that have been used by tree breeders include timber yield, photoperiodic adaptation, high reproductive capacity, tree shape, wood quality, competitive ability, and resistance to bacteria, fungi, insects, viruses, low temperature and other unfavourable environmental conditions. These characters are considered in general and with special reference to the tree genera include *Tectona grandis*. A glossary of the technical terms used in the bulletin and a bibliography of 605 references are appended.

0798 Singh, R.V; Gupta, G.C; Sharma, K.C. 1970. **Selection of Chil seed stands in Himachal Pradesh**. Proceedings of Seminar-cum-Workshop on Genetic Improvement Forest Tree Seed in India, Dehra Dun: 51-55.

0799 Soerianegara, I; Toda, R. 1974. **Forest tree improvement in Indonesia**. Forest tree Breeding in the World, Asia and Oceania: 146-153. Government Forest Experiment Station, Tokyo, Japan.

Six types of *Tectona grandis* are recognized, based on wood and stem characteristics. In provenance material trials, results after 25 years indicated that the best material for stem form and branching originated from Laos; for height from Malabar, Laos and from four sites in Indonesia; and for girth Malabar, Laos, Thailand and Indonesia. Details are given of FAO teak provenance trials laid down in 1959 at three Javanese sites.

0800 Swain, D; Mandal, A.K; Sharma, R. 1999. **Genetic analysis in teak (*Tectona grandis*)**. Journal of Tropical Forest Science 11(3): 582-586.

A genetic analysis of quantitative characters in teak was done using growth data from two progeny trials in Orissa. The seed used in the trial was from a clonal orchard composed of six clones selected from provenances from Orissa. The first trial was aged 8, and was established in 1986 with seed from 5 clones which flowered in 1984. The second trial was aged 7 years, and was established in 1987 with open pollinated seed from all 6 clones which flowered in 1985, so that 5 of the clones were common to both the trials. The results indicated the presence of considerable genetic variation for height, diameter and basal area. Moderately high to very high heritability and genetic gain values suggested the predominant role of additive gene action.

0801 Swain, D; Mohanty, S.C; Sharma, R; Mandal, A.K; Gupta, B.N. 1996. **Preliminary analysis of quantitative characters in teak**. Proceedings of the Indian National Science Academy. Part B Biological Sciences 62(2): 169-172.

The genetic architecture of quantitative characters in teak was studied in young trees raised from 27 half-sib families selected from phenotypically superior (plus trees) and established in a seed orchard in Orissa. By taking the growth measurements, it is found the presence of considerable genetic variation in the material. A preponderance of additive gene action was noticed for height, as evidenced by both high heritability and genetic gain values.

0802 Tewari, D.N. 1994. **Biodiversity and forest genetic resources**. 329p. International Book Distributors, Dehra Dun.

This book is a compilation of information on forest genetic resources and related biotechnological studies written with the aim of improving forest plantation productivity, sustainable forest management and conservation of biodiversity, with particular reference to India. It is covering information on international initiatives on genetic resource conservation with particular reference to tropical forests, the relations between conservation and tree breeding/tree improvement, and between genetic resources and forest management or plantation forestry, and the role and activities of international, national and regional organizations, seed technology, vegetative propagation by cuttings, tissue culture and provenance and tree improvement studies of major Indian species including *Tectona grandis*.

0803 Thorenaar, A. 1930. **Selection of teak - *Tectona grandis* Linn.f.** (Dutch). Tectona 23: 826-837.

0804 Venkatesh, C.S; Toda, R. 1974. **Forest tree improvement work in India: History, organization and present activities**. Forest tree Breeding in the World, Asia and Oceania: 137-145. Government Forest Experiment Station, Tokyo.

Following a brief account of the history of forest-tree breeding, information is provided on selection for height, trunk diameter and stem straightness, vegetative propagation techniques and resistance to *Hapalia machaeralis* and *Hyblaea puera* in *Tectona grandis*.

0805 White, K.J. 1962. **Tree breeding with teak (*Tectona grandis*)**. Australian Forestry 26(2): 90-93.

It is indicated that flowering is axillary and only apparently terminal because flowering usually puts an end to terminal growth. Examination of ca. 14,000 trees of 18 months old of which ca. 7.6 percent had flowered in 1961, revealed 26 trees in which vigorous terminal growth continued past the flower zone, i.e. 2.4 percent of the trees that flowered continued apical growth. Seed has been harvested from these trees, and if the characteristic of continued apical growth after flowering proves to be inherited, the teak breeder will have a valuable tool at his disposal.

0806 Wood, P.J. 1966. **Tree breeding work with teak in Tanzania**. Tanzania Silvicultural Research Note 1966.

The history of teak plantations in Tanzania is traced back to 1898 and provenance trials from India, Pakistan, Java, Trinidad, Sudan, Nigeria, Saigon, New Britain and Tanzania are described. Progeny tests of seed collected from open pollinated thirty eight seed trees are also described. Preliminary trials on grafting teak on one year old stocks is also tried.

0807 Wyatt Smith, J; Lowe, R.G. 1973. **Heritability of vigour in *Tectona grandis***. Federal Department of Forest Research, Nigeria, Research Paper Forest Series 11: 7p.

A comparison was made of the vigour of scions collected from (a) dominant trees, and (b) satellite sub-dominant trees, in a stand of 14-year-old *T. grandis*. The results show that Rohmeder's findings for temperate species in Germany are also applicable to *T. grandis*: heritability is not the major factor affecting growth, and the relative vigour of trees within an even-aged stand is determined mainly by environmental factors. Implications for tree breeding are discussed.

Go top

Plant Pollination

(See also 1412)

0808 Bhattacharya, A; Mandal, S. 1997. **Anthesis, pollen production and release of some angiospermic plant taxa**. Environment and Ecology 15(2): 283-287.

Anthesis, pollen production and pollen release were studied in ten species including *Tectona grandis* from West Bengal. The anther dehisced after anthesis in *T. grandis*.

0809 Bhattacharya, A; Mandal, S. 2000. **A contribution to the diversity of insects with reference to pollination mechanism in some angiosperms**. Biodiversity and environment. Proceedings of the National Seminar on Environmental Biology, Visva Bharati University, Santiniketan, India, 3-5 April 1998: 197-204. A.K. Aditya; P. Haldar, Eds. Daya Publishing House, Delhi.

Pollination is an important phenomenon for gene recombination as a result of which genetic and species diversity is promoted. Regular observation on the pollination mechanism of five angiosperm plants including *Tectona grandis* revealed that different members of Thysanoptera, Hymenoptera, Lepidoptera, etc. visited flowers and enhanced pollinating potential.

0810 Bhumibhamon, S; Atipanumpai, L; Kanchanarangsri, S. 1981. **Fruit production in teak seed orchards**. IUFRO XVII World Congress, Kyoto, Japan.

The study investigated fruit production in a ten year old teak seed orchard in Thailand; variation in the age of flowering was attributed to genetic control and it was indicated that teak ramets required fourteen years to reach flowering/fruiting maturity. Most clones showed more small fruits than medium and big ones in the ratio 46:36:18 respectively. Further studies on pollination and silvicultural practices to improve fruit size and quality were noted.

0811 Bryndum, K; Hedegart, T. 1969. **Pollination of teak (*Tectona grandis* Linn.f.)**. Silvae Genetica 18(3): 77-80.

Reports observations at the Thai-Danish Teak Improvement Centre, Thailand on flowering in teak, and the results of experiments in controlled pollination. Emasculation and isolation is carried out. It is reported that the early afternoon is the best time for pollination. Insects are the chief natural pollinators. Teak is mainly a cross-pollinating species, though it will fruit after selfing.

0812 Cameron, A.L. 1968. **Forest tree improvement in New Guinea. I. teak**. Proceedings of the 9th Commonwealth Forestry Conference, New Delhi, 1968: 8p.

The author discusses teak pollination.

0813 Egenti, L.C. 1975. **Preliminary studies on pollinators of teak (*Tectona grandis* Linn.f.)**. Forest Series, Federal Department of Forest Research, Nigeria, Research Paper 29: 7p.

Six main species responsible for pollination were identified, including 3 species of Nymphalidae, and Nomia spp. These insects were not present outside the flowering period.

0814 Egenti, L.C. 1978. **Pollen and stigma viability in teak (*Tectona grandis* Linn.f.)**. Silvae Genetica 27(1): 29-32.

In pollination tests in plantations near Ibadan, Nigeria, the highest percentage fruit set was obtained with pollen used on the day of anthesis. In vitro tests showed 14 percent sucrose to be the most favourable medium for pollen germination. The percentage of germination was not reduced after storage of pollen for thirty five days in a vacum desiccator.

0815 Gunaga, R; Vasudeva, R. 2002. **Variation in flowering phenology in a clonal seed orchard of teak (*Tectona grandis* Linn.f.)**. Journal of Tree Science 21(1/2): 1-10.

A nineteen year old clonal seed orchard of teak showed a large variation in flowering phenology among twenty four clones. Flowering was asynchronous with two distinct episodic peaks of flowering initiation of May to July and July to August. Provenance effect on flowering phenology was observed. Various flowering phenophases showed high heritability on individual tree.

0816 Hedegart, T. 1973. **Pollination of teak (*Tectona grandis* Linn.f.)**. Silvae Genetica 22(4): 124-128.

Natural pollination of teak is effected mainly by insects, in particular by two species of Apidae. The fertilization percentage after natural pollination was generally low, and this is ascribed to an insufficient number of pollinating insects. Success of controlled cross-pollination by hand was much greater, and it is suggested that with large-scale crossing studies, the very slow procedure for controlled pollination should be drastically simplified by omission of emasculation and isolation.

0817 Indira, E.P; Mohanadas, K. 2002. **Intrinsic and extrinsic factors affecting pollination and fruit productivity in teak (*Tectona grandis* Linn.f.)**. Indian Journal of Genetics and Plant Breeding 62(3): 208-214.

Though clonal seed orchard establishment has progressed very well in the country, low fruit productivity has hampered the teak improvement programmes to a great extent. The field studies as well as laboratory experiments led to the conclusions that inadequate pollinator activity, low pollen-ovule ratio, self-incompatibility and fruit abortion due to dominance effect of floral initiation and fungal infection are the main causes for low fruit productivity in teak.

0818 Kjaer, E.D; Suangtho, V. 1995. **Outcrossing rate of teak (*Tectona grandis* (L.))**. Silvae Genetica 44(4): 175-177.

The outcrossing rate of *T. grandis* was estimated by determining the allozyme variation at 4 loci in progenies from 15 trees collected near Ngao, Thailand. The results suggested that teak is mainly an outcrossing species, which is in agreement with results from controlled pollinations.

0819 Mathew, G; Koshy, M.P; Mohanadas, K. 1987. **Preliminary studies on insect visitors to teak (*Tectona grandis* Linn.f.) inflorescence in Kerala, India**. Indian Forester 113(1): 61-64.

Preliminary results showed that insect activity was greater during the cooler morning hours. Seventeen species were identified, 13 from the order Hymenoptera, 2 Diptera and 2 Lepidoptera. The hymenopterans were the most frequent visitors, especially the solitary bees *Prosopis pratensis*, *Allodope marginata* and *Halictus* sp. It is suggested that the possibility of enhancing pollination with domestic bee species be investigated.

0820 Mohanadas, K; Mathew, G; Indira, E.P. 2002. **Pollination ecology of teak in Kerala**. KFRI Research Report 225: 36p. Kerala Forest Research Institute, Peechi.

An investigation was undertaken to study the breeding system and various aspects of pollination in teak. In Kerala, flowering of teak trees generally coincides with the South-West monsoon. On an average, each tree bears more than 300 inflorescence. The number of flowers in an inflorescence varies from 5000 to 7000 and it takes 30-40 days for the flowering to complete a single inflorescence. Studies show that teak prefers cross-pollination although a certain amount of selfing could also be observed. Insects were found to play a major role in pollination. The insects observed on the teak inflorescence were also identified. Factors leading to premature fruit fall was also investigated and a fungus *Phomopsis* sp. was also found to be the major cause.

0821 Narendran, T.C; Jobiraj, T; Mohandas, K. 2000. **A remarkable new species of the bee genus *Halictus* Latreille (Hymenoptera: Apoidea: Halictidae) from India**. Journal of Advanced Zoology 21(1): 48-50.

Halictus tectonae sp. nov., a pollinator of teak flowers in Kerala, India, is reported.

0822 Palupi, E.R; Owens, J.N. 1997. **Pollination, fertilization, and embryogenesis of teak (*Tectona grandis* Linn.f.)**. International Journal of Plant Sciences 158(3): 259-273.

Three clones representing low, intermediate, and high fruit-production capacity in teak were selected from a clonal seed orchard in East Java, Indonesia. Low fruit and seed set were the major constraints in fruit production. Most teak pollen germinated and pollen tubes reached the ovary or micropyle 24 h AFO. Some abnormalities in pollen-tube growth were observed. The major cause of fruit abortion is abnormal development of the endosperm.

0823 Sasidharan, K.R; Nagarajan, B; Nicodemus, A; Mahadevan, N.P; Durai, A; Gireesan, K; Varghese, M. 1999. **Insect pollination versus enhanced fruit production in *Tamarindus indica* and *Tectona grandis***. Journal of Palynology 35/36: 93-97.

Experiments were conducted to investigate the floral biology, flower visitors and fruiting aspects of *Tamarindus indica* and *Tectona grandis* from Coimbatore, Tamil Nadu. The functional aspects of flowers in relation to the foraging activity and probing behaviour of flower-visitors were observed. Teak flowers were foraged during day time by insects belonging to orders Diptera, Hymenoptera, Lepidoptera, Coleoptera and Hemiptera.

0824 Subramanian, K; Seethalakshmi, T.S. 1984. **A preliminary note on pollen in teak in relation to fruit-set**. Indian Forester 110(10): 1023-1029.

A study was made of pollen grains of teak from Chanda, Chikhalda, Nagpur, Sawantwadi and Pune, Maharashtra, in an attempt to correlate sterility in pollen grains with poor fruit set. The percentage of sterility is found insignificant, it was concluded that pollen sterility as a major factor for poor seed set can be ruled out. Investigations on pollen viability and stigmatic receptivity are suggested.

0825 Tangmitcharoen, S. 1997. **Controlled hand-pollination of teak**. Teaknet Newsletter 7: 4-6.

This is an extract from 'A manual on techniques for controlled hand-pollination of teak. The manual is based on tree breeding studies by Thailand's Royal Forest Department, and a literature review. The extract gives brief details of procedures to be used.

0826 Tangmitcharoen, S; Owens, J.N. 1996. **Floral biology, pollination and pollen-tube growth in relation to low fruit production of teak (*Tectona grandis* Linn.f.) in Thailand**. Tree improvement for sustainable tropical forestry. QFRI IUFRO Conference, Queensland, Australia, 27 October-1 November 1996. Volume 1: 265-270. M.J. Dieters; A.C. Matheson; D.G. Nikles; C.E. Harwood; S.M. Walker, Eds. Queensland Forestry Research Institute, Australia.

Teak flowers are weakly protandrous. The papillate stigma is of the wet type with a hollow style and a short receptive period. The major pollinators are *Ceratina* spp. The main cause for low fruit set in teak is lack of insect pollinators and their effectiveness. Although 78 percent of flowers are pollinated in open pollination, there is a high rate of selfing. Late-acting gametophytic self-incompatibility, or post-zygotic abortion probably are the causes of high early fruit abortion.

0827 Tangmitcharoen, S; Owens, J.N. 1997. **Floral biology, pollination, pistil receptivity, and pollen tube growth of teak (*Tectona grandis* Linn.f.)**. Annals of Botany 79(3): 227-241.

An account is given of floral morphology, pollen shedding and structure, stigma development and receptivity, insect visitors to flowers, the pathway of pollen tube growth to the embryo sac and rate of pollen tube growth, and pollination success and the pollen-ovule ratio.

0828 Tangmitcharoen, S; Owens, J.N. 1997. **Pollen viability and pollen-tube growth following controlled pollination and their relation to low fruit production in teak (*Tectona grandis* Linn.f.)**. Annals of Botany 80(4): 401-410.

Results are discussed of pollen viability and longevity, the patterns and rates of in vitro and in vivo pollen-tube growth following controlled pollinations, various abnormalities observed in *in vivo* pollen-tube growth, rate and form of self-incompatibility, reproductive success, fruit set and rate of fruit abortion.

0829 Thangaraja, A; Senthilkumar, N; Ganesan, V. 2001. **Foraging dynamics of floral visitors of *Tectona grandis* Linn.f. (Verbenaceae)**. Insect Environment 7(3): 133-134.

It is found that a total of nine flower visitors, Graphium sarpedon choredon, Papilio polymnestor, Apis cerana indica, Apis mellifera, Oecophylla smaragdina, Musca domestica, Tabanus atratus, Mylabris pustulata and Xylocopa sp. were observed, 5 of them were found to be nectar and pollen foragers. In teak flowers, the diurnal activity of flies began at 06.00 h, which became normal up to 09.00 h. There was a declining trend in foraging activity up to 12.00 h, which became normal up to 11.00 h.

0830 Vasudeva, R; Gunaga, R; Hanumantha, M. 2000. **Non-synchronous flowering in teak seed orchards - a cause for low fruit production**. National Symposium on Forestry towards 21st Century, Tamil Nadu. Agricultural University, Coimbatore.

0831 Zeya, A. 1982. **Detrimental effects of some insects on teak fruit yield**. Research Leaflet 14. Forest Research Institute, Burma.

Reduction in teak fruit production and possible reduction in teak seed germination rates due to insects were investigated. Methods for protection and control of insects having detrimental effects on production of viable fruits in seed orchards are proposed.

Go top

Genetic Improvement

(See also 0812, 1422, 3105, 3413, 4011, 4485, 4489)

0832 **Teak Improvement Centre**. Progress Report 6, 1967: 13p. Teak Improvement Centre, Ngao.

Reported the activities of the centre during the last 6 months which includes mainly establishment of seed orchards by budding, provenance trials and selection of seed source areas. The research projects include pollination studies and developing techniques and methods of isolation and controlled pollination and comparison of results with self pollination and wind pollinations.

0833 **Teak Improvement Centre**. Progress Report 7, 1967: 12p. Teak Improvement Centre, Ngao.

Reported the activities of the centre of six months upto July 1967. Improvement programme under taken includes selection of plus trees, establishment of seed orchards and enlarging their areas, budding research for vegetative propagation and provenance trials. The research studies cover budding techniques and time of budding, seed and nursery investigations, fertilizer effects, controlled pollinations and grading and splitting of stumps.

0834 **Teak Improvement Centre**. Progress Report 8, 1968: 12p. Teak Improvement Centre, Ngao.

Reported the work carried out by TIC during the period of six months upto January 1968. The improvement programme includes extension of clone collections, establishment of seed orchards and carrying out provenance trials. The research programmes cover, both vegetative and generative propagation studies, mainly on budding techniques, seasons and storing budwood and use of graded stumps, split stumps etc. and 1700 controlled pollinations were made with 12 percent. Success in fruit formation and 55 saplings after isolation were also carried out.

0835 **Teak Improvement Centre**. Progress Report 11, 1968: 9p. Teak Improvement Centre, Ngao.

Progress report of the work done during the period of six months upto July 1968. The teak improvement programmes were plus tree selection, clonal collections, seed orchards, establishment and provenance trials and research programmes include autumn budding and green budding trials, spacing trial in plantations, grading of stumps, continuation of pollination studies, and mechanization of nursery work.

0836 **Teak Improvement Centre**. Progress Report 12, 1969: 9p. Teak Improvement Centre, Ngao.

A report of DANIDA on progress made by the centre in clone collection, seed orchards, provenance tests etc.

0837 **Teak Improvement Centre**. Progress Report 13, 1969: 3p. Teak Improvement Centre, Ngao.

Reported the activities of TIC for the period of six months upto July 1969. The improvement programme includes plus trees selection, seed orchard work and provenance testing. Research programmes cover, use of potted stumps for budding, rooting, cuttings, sowing rate, machine treatment of seed and use of cover crop in Mae-Gar seed orchard.

0838 **Teak Improvement Centre**. Progress Report 14, 1970: 17p. Teak Improvement Centre, Ngao.

Reported the activities of the TIC during the period of six months upto January 1970. The activities reported include provenance research (testing of earlier field trials, collection and processing of data), breeding (studies on natural pollination and comparison with controlled hand pollination), seed orchard work, clone collections and extension of multiplication gardens), silviculture and nursery research includes tending, collection and processing of data and training programme.

0839 **Teak Improvement Centre**. Progress Report 15, 1970: 14p. Teak Improvement Centre, Ngao.

The report includes the activities of provenance research, breeding research, seed orchards, silvicultural research and nursery research and training counterparts.

0840 **Teak Improvement Centre**. Progress Report 18, 1971: 15p. Teak Improvement Centre, Ngao.

Six months report of the various activities of TIC upto January 1971 under the headings, provenance research, breeding, silviculture, nursery, tending and miscellaneous items.

0841 **Teak Improvement Centre**. Progress Report 21, 1971: 9p. Teak Improvement Centre, Ngao.

Reported the activities of TIC for the period of six months upto July 1971 under the heading provenance research, breeding (selection of plus trees in plantations and seed orchard work), silviculture (pruning experiments, spacing trials, weeding trials, seed production in relation to site class and stand age, optimum stump size for transplanting) and nursery research (early pulling and storing of stumps, long term (0-5 years) seed storage results. Optimum sowing time, and time and method of fertilizer application. Production of potted root stocks and root growth and training and miscellaneous items.

0842 **Teak Improvement Centre in Thailand - Description and Evaluation**. Report by Mr.H. Keiding to DANIDA in 1971 on the evaluation of TIC since 1965 to date, 1971: 17p. Teak Improvement Centre, Ngao.

An evaluation report since the starting of the TIC in 1965, giving the background history and reviewing the achievements and impacts of TIC on Tai Forestry service and forest industry organizations. The results include provision of material for breeding, organization of seed collection, distribution and utilization, coordination with other fields of forestry and forest organizations, training and silvicultural research.

0843 **Teak Improvement Centre**. Progress Report 22, 1972: 15p. Teak Improvement Centre, Ngao.

Reported the activities of TIC for the period of six months upto January 1972 under the items provenance research, breeding, silvicultural research, nursery research and training of counterparts.

0844 **Teak Improvement Centre**. Progress Report 23, 1972: 11p. Teak Improvement Centre, Ngao.

The report covers the activities of TIC for six months upto July 1972 in the fields of (1) provenance trials (nursery and field trials) (2) breeding work (seed orchards) management of seed source areas, clonal collections, pollination and stump budding and grafting investigations; (3) silvicultural-section (deals with spacing trials, weeding trials, pruning studies, and (4) nursery section (stump storage equipment, seed storage and studies on the influence of collection time on germination.

0845 **Teak Improvement Centre**. Progress Report 24, 1973: 23p. Teak Improvement Centre, Ngao.

The annual report of the activities of TIC which include seed orchard work, seed source areas, clone collections, pollinations, investigations, stump, budding, and multiplication garden work, spacing and weeding trials, pruning and thinning studies, and nursery investigations cover studies on seed quality, stand age and site quality, standard testing of teak seed, seed storage, and use of fertilizers, storage of stumps and seedlings etc.

0846 Ansari, A.A; Shrivastava, R.K; Anjana Rajput. 2002. **A report on new hybrid SFRI JBP/1 & SFRI JBP/2 of teak**. Vaniki Sandesh 26(3/4): 31-33.

This paper discusses the production of two new hybrids of teak achieved through controlled crossing.

0847 Apichart Kaosa ard. 1989. **Teak improvement strategy in Thailand**. Breeding Tropical Trees: Population structure and genetic improvement strategies in clonal and seedling forestry. Proceedings of the IUFRO Conference, Thailand, November 1998: 250-258. Oxford Forestry Institute, Oxford and Winrock International, Virginia.

Teak improvement programme in Thailand has been set up for more than two decades. One of the remarkable features of this programme is the possibility to create superior clones for mass clonal propagation by means of tissue culture techniques for the clonal planting programme. The breeding methods are described in this paper.

0848 Apichart Kaosa ard. 1992. **Teak international provenance trial I: Growth and stem quality**. Proceedings of the Seminar on 50 Anniversary of Huay-Tak Teak plantation, Bangkok, 5-8 August 1992.

14 year-old teak provenance trial, established inside the Mae Huad plantation was assessed and evaluated for their growth, stem quality and health performance. The trial consist of 8 provenances, Indonesia, India and Thailand. The study showed that Thai and Indonesian provenances performed much better, in terms of growth and stem quality and the Thai provenance was the most superior provenance among the tested provenances.

0849 Apichart Kaosa ard. 1992. **Teak international provenance trial II: Wood production and qualities**. Proceedings of the Seminar on 50 Anniversary of Huay-Tak Teak plantation, Bangkok, 5-8 August 1992.

Two international teak provenance trials were assessed for wood production and wood properties in 1991.

0850 Apichart Kaosa ard. 1998. **Teak breeding and improvement strategies**. Teak for the Future, Proceedings of the 2nd Regional Seminar on Teak, Yangon, Indonesia, 29 May-3 June 1995: 41-81.

0851 Apichart Kaosa ard. 2000. **Gains from provenance selection**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 191-208. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

The paper reviews provenance variation expressed in genotypic values at local and international levels and provenance x region matching.

0852 Apichart Kaosa ard; Suangtho, V; Kjaer, E.D. 1998. **Experience from tree improvement of teak (*Tectona grandis*) in Thailand**. Danida Forest Seed Centre Technical Note 50. Danida Forest Seed Centre, Denmark.

Tree improvement activities are initiated in the country in order to obtain gains in selected characters. The large differences in growth conditions within the natural range of teak indicate the existence of genetic differences between origins. Discussed the teak improvement activities in Thailand which include selection of plus trees and establishment of clonal seed orchards, seed production areas and development of vegetative propagation techniques.

0853 Apichart Kaosa ard; Suangtho, V; Kjaer, E.D. 1998. **Genetic improvement of teak (*Tectona grandis*) in Thailand**. Forest Genetic Resources 26: 21-29.

Teak breeding in Thailand is discussed by considering seed requirements, genetic variation and genetic gain. Improvement activities undertaken in Thailand are described, including the selection of plus trees and establishment of clonal seed orchards, seed production area, and development of vegetative propagation techniques. Information is provided on the conservation of genetic resources, both *in situ* and *ex situ*, and lessons that can be learnt for future breeding programmes.

0854 Aung, M.M. 2002. **State of forests and forest genetic resources in Myanmar**. Proceedings of the Southeast Asian moving workshop on conservation, management and utilization of forest genetic resources, Thailand, 25 February - 10 March 2001. J. Koskela; S. Appanah; A.P. Pedersen; M.D. Markopoulos, Eds. FORSPA Publication 31: 65-74. FAO Regional Office for Asia and the Pacific, Bangkok, Thailand.

The status of forests and forest genetic resources in Myanmar was assessed based on forest cover, number of plant species, forest types by area and vegetation type, wood volume by vegetation type, and the permanent forest estate data. Forest resources utilization and management are discussed. A special teak plantation programme in the country is discussed.

0855 Bagchi, S.K. 1995. **Selection differential and predicted genetic gain in *Tectona grandis***. Indian Forester 121(6): 482-490.

In a study of selected plus trees and comparison trees of teak at 80 locations in Karnataka, Tamil Nadu and Kerala, selection differential and predicted genetic gain values were estimated. This involved individual character variation analysis, estimation of heritability and computation of predicted gain values. Predicted gain values were estimated for individual batches along with an overall estimate.

0856 Bagchi, S.K. 1998. **Differential response in parameters due to location of planting sites in *Tectona grandis*. I. Mean and critical difference**. Indian Journal of Tropical Biodiversity 3/6(1/4): 27-34.

A study was conducted to assess the area wise variability of different groups of phenotypically superior teak plants from southern India showing within group and between group variations in five characters. It was concluded that selection and mass vegetative propagation producing large number of plantlets for the purposes of raising plantation may result in higher productivity.

0857 Bagchi, S.K. 2000. **Differential response in parameters due to location of planting sites in *Tectona grandis*-II. Analysis of variance**. Indian Journal of Forestry 23(1): 57-60.

A statistical analysis is made of growth data from a tree improvement programme for *Tectona grandis* in different forest divisions in three states of Tamil Nadu, Kerala and Karnataka. Growth measurements made included total height, clear bole length, diameter at breast height and crown length. It was reported that there were significant growth differences among and within forest divisions. It is also indicated significant differences is not only in between batch components, but also within batch components. This shows the presence of an additive variance component that can be exploited through stringent selection.

0858 Balasubramanian, R; Kumaravelu, G. 1981. **Isoenzymes of leaf peroxidases to distinguish clones of *Tectona grandis***. Indian Journal of Forestry 4(4): 258-260.

Polyacrylamide disc gel electrophoresis studies showed differences in leaf peroxidases between plus trees and a check tree.

0859 Beard, J.S. 1943. **The importance of race in teak, *Tectona grandis* Linn.f.** Caribbean Forester 4: 135-139.

Teak has been raised in Trinidad from seed imported both from Southern India and Burma, seed from the latter source giving much the better growth under the prevailing conditions.

0860 Bhat, K.M; Indira, E.P. 1997. **Specific gravity as selection criterion of genetic improvement of teak wood quality: Tree breeder's perspective**. Timber management toward wood quality and end product value. Proceedings of the CTIA IUFRO International Wood Quality Workshop, Quebec City, Canada, 18-22 August 1997: IV.91-IV.96. S.Y. Zhang; R. Gosselin; G. Chauret, Eds. Forintek Canada Corporation, Canada.

The study examines the scope for choosing wood specific gravity as the selection criterion of overall genetic improvement of timber strength of teak - a ring-porous tropical hardwood.

0861 Bingchao, K. 1996. **Evaluation on aggregate genetic value of main characters of provenances of teak**. Forest Research, China 9(1): 7-14.

0862 Boonkird, S. 1954. **Progress report on the first teak-tree show in Thailand**. Natural History Bulletin of the Siam Society 20(4): 243-256.

Gives an account of the work done by the Thai-Danish Teak Improvement Centre and discuss the importance of tree in tree breeding programmes.

0863 Boontawee, B; Apichart Kaosa ard; Piyapan, P. 1992. **Teak seed orchards in Thailand**. Proceedings of the Seminar on 50 Anniversary of Huay-Tak Teak plantation, Bangkok, 5-8 August 1992.

0864 Bor, N.L. 1939. **Summary of the results to date of the All India co-operative teak seed origin investigation**. Proceedings of 5th Silvicultural Conference, Dehra Dun: p115.

Lists, leaf variations, characteristics and descriptions of ten origins of teak in size, colour, texture etc. and a key was compiled and presented for their identification.

0865 Britwum, S.P.K. 1978. **Species and provenance selection of tropical hardwood species with special reference to West Africa**. World Consultation on Forest Tree Breeding, 3rd, Canberra, Australia, 21-26 March 1977. v.1: 143-154. CSIRO, Australia.

This paper presents the efforts made in provenance studies of tropical hardwood species and emphasizes the need for centralised co-operation programmes on regional levels for seed collection and provenance studies of indigenous species. Provenance trials of exotic species *Tectona grandis* which have been established on national level through international co-operation have also been discussed.

0866 Burley, J; Kemp, R.H. 1973. **Centralised planning and international co-operation in the introduction and improvement of tropical tree species**. Commonwealth Forestry Review 52(4): 335-343.

Discusses the value of centralized planning of tree-breeding work, with examples of several existing co-operative programmes including the activities of FAO and IUFRO and of three centres, the Commonwealth Forestry Institute, Oxford, the Danish seed centre and Pine and Teak centres in Thailand and the Forest Research Institute, Canberra and the Philippines).

0867 Cameron, A.L. 1966. **Genetic improvement of teak in New Guinea**. Australian Forestry 30(1): 76-87.

The programme involves provenance testing, individual tree selection, seed-orchard establishment, clonal and progeny testing, and studies on heritability. Two 10-acre clonal seed orchards have been established.

0868 Chadhar, S.K. 1994. **Preliminary performance of some provenances of teak in Seoni District of Madhya Pradesh**. Vaniki Sandesh 18(4): 28-31.

Ten-year performance data are given for 8 Indian provenances of teak.

0869 Changtragoon, S; Szmidt, A.E. 2000. **Genetic diversity of teak (*Tectona grandis* Linn.f.) in Thailand revealed by random amplified polymorphic DNA markers**. IUFRO Conference on Tropical Species Breeding and Genetic Resources: Forest Genetics for the next Millennium, Durban, South Africa, 8-13 October 2000: 82-83.

0870 Chaudhari, N.R. 1970. **Experience with raising of teak seed orchard in Maharashtra state**. Proceedings of the Seminar cum Workshop on General Improvement of Forest Tree Seed in India, Dehra Dun: 56-67.

The paper describes experience gained in starting a teak orchard in Maharashtra state. The works involves discovery of superior trees of teak, bud grafting, preparation of site for orchard, planting of grafts and their care. In the end gives percentage success of but grafts made in different months and percentage success of bud grafts made by different individuals.

0871 Chawhaan, P.H; Khobragade, N.D; Mandal, A.K. 2003. **Genetic analysis of fruit and seed parameters in teak (*Tectona grandis* Linn.f.): Implications in seed production programme**. Indian Journal of Genetics and Plant Breeding 63(3): 239-242.

Genetic analysis of fruit and seed parameters in teak was conducted using open-pollinated fruits from more than 40 trees of Madhya Pradesh. The results indicated highly significant variation for all the characters studied. Implications of the present findings in seed production programme of teak have been discussed.

0872 Chawhaan, P.H; Mandal, A.K. 2003. **Impact of genetically improved seeds in enhance-**

ment of productivity of plantations: A case study of teak. TEAKNET 31: 1-4.

Considering the magnitude of genetic diversity and commercial value of the species, teak improvement work in India was initiated during early sixties. These activities resulted in selection of phenotypically superior trees, establishment of seed production populations and breeding populations. Here reports the impact of use of improved seed in increasing the volume production of teak plantations.

0873 Commonwealth Forestry Institute, Oxford. 1978. **Progress and problems of genetic improvement of tropical forest trees. Proceedings of a joint workshop, IUFRO working parties S2.02-08 and S2.03-01, Brisbane, 1977. V. Provenance trials and breeding programmes. F. *Tectona grandis* Linn.f: 730-807. D.G. Nikles; J. Burley; R.D. Barnes, Eds**. Commonwealth Forestry Institute, Oxford, UK.

Reports are given on international trials in Ivory Coast, Nigeria, Andhra Pradesh, Upper Volta, Sri Lanka, and Jari, Para, Brazil. A review of contributions is included.

0874 Commonwealth Forestry Institute, Oxford. 1984. **Provenance and genetic improvement strategies in tropical forest trees. Proceedings of a joint conference of IUFRO S2.02 08, S2.03-01, S2.03-13, Mutare, Zimbabwe, 9-14 April 1984: 1-148**. Commonwealth Forestry Institute, Oxford.

Following papers are included: 1. Inbreeding, hybridization and conservation in provenances of tropical forest trees, 2. Evaluation of a series of teak and gmelina provenance trials - selection of traits, their assessment and analysis of observations, 3. Design, management and assessment of species, provenance and breeding trials of multipurpose trees, 4. Provenance X environment interaction; its detection, practical importance and use with particular reference to tropical forestry, 5. Strategies for the incorporation of new provenance material in existing breeding populations of tropical forest trees, 6. Influence of propagation by cuttings on the breeding strategy of forest trees.

0875 Connelly, S. 1990. **Final assessment of teak provenance trial at Wanniyagama**. Sri Lanka Forester 19(3/4): 69-70.

Preliminary results of the provenance trial of teak conducted in Sri Lanka are presented.

0876 Dabral, S.L; Wadeturer, R.N. 1977. **A concise field manual on raising teak seed orchard**. MVSS Forest Records 1.

0877 Davidson, J; Howcroft, N.H.S. 1973 . **Papua New Guinea tree improvement and introduction progress report 1972**. Papua New Guinea, Tropical Forestry Research Note SR.1: 15p.

A report prepared for the meeting of Research Working Group No. 1 of the Research Committee of the Australian Forestry Council on Tree Improvement and Introduction, Mt. Gambier, S. Australia, November 1972. It summarizes improvement work done up to 1972 on different species including *Tectona grandis*.

0878 Delaunay, J. 1977. **Results of *Tectona grandis* Linn.f. provenance trials six years after initiation in Ivory Coast**. Proceedings of the Joint IUFRO Workshop, Brisbane Vol.2: 734-742.

0879 Delaunay, J. 1978. **Results of provenance trials with teak, *Tectona grandis*, six years after planting in Ivory Coast**. (French). World Consultation on Forest Tree Breeding, Canberra, Australia, 3rd, 21-26 March 1977. v.1: 273-284.

Seeds collected from India, Thailand, West Africa and Tanzania plantations of the species *Tectona grandis* were used to lay out a provenance trial in Ivory Coast. Assessments on vigor, quality of boles and flowering have been statistically analysed.

0880 Devar, T.A.M. 1970. **Forest tree improvement programme in Tamil Nadu**. Proceedings of the Seminar-cum-Workshop on General Improvement of Forest Tree Seeds in India: 36-45. FRI, Dehra Dun.

Describes seed orchard and teak seed origin experiments in the state from 1932 onwards for teak along with wattle, cashew, eucalypt and sandal.

0881 Egenti, L.C. 1977. **Observations on vigour and form of teak (*Tectona grandis* Linn.f.) from local and international provenances in Nigeria**. Obeche 13: 53-69.

Provenance trials were set up in 3 sites: Akilla (rain-forest), Ibadan (moist semi-deciduous forest) and Olokemeji (mixed deciduous forest and derived savanna). It is found that the survival and growth were best at Akilla, although the other sites had twice as many straight-stemmed trees.

0882 Egenti, L.C. 1977. **The international provenance trials of teak (*Tectona grandis* Linn.f.) in Nigeria**. Proceedings of the Joint IUFRO Workshop, Brisbane Vol.2: 754-760.

0883 Egenti, L.C. 1978. **The Danish/FAO international provenance trials of *Tectona grandis* in Nigeria**. Indian Forester 104(4): 227-237.

One-year-old seedlings of 20 provenances of *T. grandis* were planted out at six sites in Nigeria. Significant differences between locations are indicated for height, girth, stem form and crown and branching. The provenances are also ranked with respect to these parameters for each site. Data on survival, fox-tailing and fruiting are tabulated.

0884 Emmanuel, C.J.S.K. 2000. **Genetical improvement of teak: Concept, application and achievement**. Genetics and Silviculture of Teak. A.K. Mandal; S.A. Ansari, Eds. International Book Distributors, Dehra Dun.

0885 Emmanuel, C.J.S.K; Kapoor, M.L; Sharma, V.K. 1992. **Three decades of forest genetics and tree improvement**. Indian Forester 118(7): 489-500.

An account is given of work carried out on the genetics and improvement of important tree species including teak by the Forest Research Institute at Dehra Dun and its sister organizations, under various projects/schemes. The use of vegetative propagation techniques in the work is also described.

0886 FAO. 1972. **Provenance collections of teak**. Forest Genetic Resources Information 2: 54-61. Rome, FAO.

Tabulated data are presented on the provenance of stored seed samples from numerous sites in 15 countries.

0887 Forest Department, Papua and New Guinea. 1962. **Genetic improvement of teak: (a) Flowering observations; (b) seed production studies**. Report of Department of Forestry, Papua and New Guinea 1962/63: 34-36.

Age of first flowering and frequency of flowering have been noted in a teak stand. One-third of the trees had flowered by the age of three years, and about one-half by 3 1/2 years, and once flowering has started it usually occurs annually. Ultimate log length has been fixed by the first flowering.

0888 Forest Tree Improvement, Arboretet Hoersholm. 1972. **Symposium on seed orchards in honour of C. Syrach-Larsen**. Forest Tree Improvement, Arboretet Hoersholm 4: 135p.

The following papers on seed orchards related to forest trees are included. 1. Seed orchards in forestry, 2. Biological and technical problems in American seed orchard development, 3. Nature's diversifying selection and its impacts on orchard breeding, 4. Certification and classification of seed orchards, 5. Seed orchards in relation to silviculture, 6. Seed orchards of hevea and teak with special reference to teak seed orchards in Thailand, 7. Seed orchard work of the Danish Health Society.

0889 Gera, M; Gera, N; Sharma, S. 2001. **Estimation of variability in growth characters of forty clones of *Tectona grandis* Linn.f.** Indian Forester 127(6): 639-644.

A study was conducted in Jabalpur, Madhya Pradesh to assess the genetic variability of teak with respect to growth characters and survival percentage and the degree of their transmission to progeny. Plant height and collar diameter gave comparable values for genotypic and phenotypic variations and coefficients of variation, indicating that these parameters are under genetic control.

0890 Gogate, M.G. 1993. **Tree improvement in Maharashtra with special reference to *Tectona grandis***. Proceedings of Workshop on Production of Genetically Improved Planting Material for Afforestation Programmes, Philippines: 16-36. K. Vivekananda; K.N. Subramanian; N.Q. Zabala; K. Gurumurti, Eds.

0891 Gogate, M.G; Gujar, D; Mandal, A.K; Sharma, R; Gupta, B.N; Lal, R.B. 1998. **Genetic analysis of quantitative characters in teak (*Tectona grandis*)**. Indian Journal of Tropical Biodiversity 3/6(1/4): 41-45.

Genetic analysis of quantitative characters in teak was made using six year growth data from a progeny test materials established with eighteen clones. The analysis revealed non-additive gene action for height and additive gene action for diameter and basal area. Moderate to moderately high estimates of heritability and genetic gain were obtained for diameter and basal area including highly significant genetic correlation for these two traits. Results have been discussed in the light of breeding strategies to be followed in teak.

0892 Goh, D.K.S; Alloysius, D; Gidiman, J; Chan, H.H; Mallet, B; Monteuuis, O. 2003. **Selection and propagation of superior teak plant material for improved quality plantation establishment: The ICSB/Cirad-forests joint project as a case study**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Materials from mature selected plus trees from a broad genetic base and seeds of presumed high genetic value but in restricted number were multiplied by using a well developed tissue culture technique at the Plant Biotechnology Laboratory. Seed lots from natural forest stands, plantations and a multi-provenance clonal seed orchard were obtained.

0893 Gopal, M. 1972. **Delimiting regions of provenance of teak for seed improvement and certification**. Proceedings of Symposium on Man-Made Forests in India, 8-10 June, 1972, Society of Indian Foresters, Dehra Dun. Forest Research Institute, Dehra Dun.

Tree seeds are classified into following four categories, seeds from known administrative region, seeds from known regions of provenance, selected seeds, and certified seeds. This paper analyses the various steps involved in production of seeds of above four categories.

0894 Gradual, L; Kjaer, E.D; Suangtho, P; Saosaard, A. 1999. **Conservation of genetic resources of teak (*Tectona grandis*) in Thailand**. Danida Forest Seed Centre, Denmark, Technical Note 52.

0895 Graudal, L; Kjaer, E.D; Thomsen, A; Larsen, A.B. 1997. **Planning national programmes for conservation of forest genetic resources**. Danida Forest Seed Centre, Humlebaek, Technical Note 48: 58p.

This note provides a practical framework for planning and implementation of national forest gene conservation programmes. Selection of priority species, assessment of their genetic variation, assessment of their conservation status, identification of population to be conserved, identification of appropriate conservation measures, organization and planning of specific conservation activities and preparation of management guidelines for the objects of conservation are described.

0896 Gunaga, R.P; Vasudeva, R. 2003. **Causes for low fruit production in clonal seed orchards of teak (*Tectona grandis* Linn.f.) in India**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

This paper deals with the causes for low fruit production in seed orchards; it reviews the available literature on the topic and attempts to suggest a few management practices.

0897 Gunaga, R; Vasudeva, R. 2002. **Genetic variation for fruiting phenology among teak clones of different provenances of Karnataka**. Indian Journal of Forestry 25(1/2): 215-220.

Significant variation is found among the clones of the clonal seed orchards for initiation and duration of fruit maturation. Clones derived from different provenances differed in their fruiting phenology and with respect to number of fruits per inflorescence. The estimates of the genetic parameters suggested that the time of fruit initiation was genetically controlled, while other traits were influenced by the environment.

0898 Hamzah, Z. 1977. **History of teak tree improvement**. (Indonesian). Duta Rimba 3(19): 21-30.

0899 Hanumantha, M. 2000. **Inter and intra clonal variation for reproductive traits in *Tectona grandis* Linn. f. Thesis**. University of Agricultural Sciences, Dharwad.

0900 Hanumantha, M; Gunaga, R.P; Vasudeva, R. 2001. **Variation for fruit parameters among teak (*Tectona grandis* Linn.f.) clones**. Journal of Tropical Forestry 17(1): 59-63.

Results of a study on fruit calyx, hairiness and splitting, which were qualitatively assessed in three rametes in a clonal seed orchard in Karnataka, India.

0901 Harahap, R.M.S; Soerianegara, I. 1978. **Heritability of some characters in teak (*Tectona grandis* Linn.f.)**. Proceedings from the Third World Consultation on Forest Tree

Breeding: Population Improvement Vol. 2: 649-657. CSIRO, Canberra, Australia.

The heritability of some characters in teak plantation has been determined.

0902 Hedegart, T. 1971. **Initiation of teak (*Tectona grandis* Linn.f.) provenance research in Thailand**. Vanasarn 29(2): 18-26.

The initial stage of provenance research on *T. grandis* by the Thai/Danish Teak Improvement Centre is described. There were significant differences between provenances in growth in the nursery, and also in survival and height. Recommendations are made on the collection of seed and the establishment of trials.

0903 Hedegart, T. 1971. **The Thai Danish Teak Improvement Centre five years after initiation**. Unasylva 25(1): 31-37.

Observations on clone collections, clonal seed orchards and provenance trials at the centre are discussed. Mention is made of a machine for removing exocarps and the results of nursery experiments are summarized.

0904 Hedegart, T. 1974. **The Teak Improvement Centre ten years after initiation**. Vanasarn 32(4): 342-358.

Reviews the activities of the Centre after ten years and presents the third 5-year programme of work on teak breeding, provenance evaluation and silviculture.

0905 Hedegart, T. 1975. **Breeding systems, variation and genetic improvement of teak (*Tectona grandis* Linn.f.)**. Tropical Trees, Variation, Breeding and Conservation. Linnean Society of London: 109-123. J. Burley; B.T. Styles, Eds. Academic Press, New York.

Available statistics of the teak forests of the world are presented. The species' breeding systems are discussed with emphasis on flowering and pollination. Stand structure, seed setting, seed distribution and regeneration are briefly discussed. The species genetic variation between populations and between individuals is reviewed. The necessity of conservation of gene resources is stressed. The importance of an economic evaluation of the breeding programme is mentioned. A proposal for global or regional coordination of research activities and education is presented.

0906 Hedegart, T. 1995. **Teak improvement for Myanmar and Laos**. FAO Consultancy Report April 1995.

0907 Hedegart, T. 1995. **Teak improvement programmes for Myanmar and Laos**. Hanoi: 29p.

0908 Hedegart, T; Lauridsen, E.B; Keiding, H; Faulkner, R. 1975. **Broad-leaved seed orchards. Part D - Teak**. Seed orchards. Forestry Commission Bulletin 54: 139-142.

Apart from several aspects of orchard establishment and management, a detailed description is given of flowering behaviour and natural pollination.

0909 Hellinga, G. 1956. **On forest tree improvement in Indonesia**. Proceedings of the IUFRO Meetings 22: p101.

0910 Hidalgo, E; Moreno, V; Morales, N. 1986. **Performance of 15 provenances of teak (*Tectona grandis*) five years after planting in Itabo, Matanzas**. (Spanish). Revista Forestal Baracoa 16(1): 65-75.

Data are presented on the survival, height and diameter of 15 provenances/sources, Indian, African, and Cuban grown on a typical red rendzina over limestone in NE Matanzas province, Cuba. The Olomu-Llorin provenance from Nigeria was very significantly superior to all other provenances. The Indian provenances were generally inferior. The Cuban sources Camaguey and Itabo can be used as seed sources until seed of the Olomu-Llorin provenance becomes available.

0911 Holmes, C.H. 1956. **Plantations and provenance trials of teak in Ceylon**. 12th Congress, International Union for Forest Research Organizations, Oxford, 1956 IUFRO/56/22/108: 2p.

Gives a brief history of introduction of teak in Ceylon. Ceylon joined in the all India Teak Seed Origin Trials in 1941 and seeds from local, Burma, Anamalai, Nilambur and Travancore origins were tried. The best results have been obtained from seeds of Indian origin. The method of pretreatment of seeds to stimulate and improve germination has also been described.

0912 Howcroft, N.H.S; Davidson, J. 1974. **Papua New Guinea tree introduction and improvement. Progress Report 1972-1974**. Papua New Guinea, Tropical Forestry Research Note 26: 9p.

Presents short reports summarizing progress made during the period 1972-1974

on different species including *Tectona grandis*.

0913 Hughes, C.E; McCarter, P.S; Apichart Kaosa ard; Koyo, J.P; Sim, B.L; Jones, N; Vigneron, P. 1984. **Voluntary papers on breeding programmes of broadleaves**. Provenance and genetic improvement strategies in tropical forest trees. Proceedings of a joint conference of IUFRO S2.02 08, S2.03-01, S2.03-13, Mutare, Zimbabwe, 9-14 April 1984: 521-618. Commonwealth Forestry Institute, Oxford.

It consists of five papers which include the paper Kaosa-ard, A. Teak improvement programme in Thailand.

0914 Indira, E.P. 1997. **Genetic improvement of teak in Kerala: Present status and future strategy**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 154-156. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

In Kerala, attempts to improve genetically the planting stock were made as early as 1961, with the selection of a few plus trees. With the joint effort of Kerala Forest Research Institute and Kerala Forest Department, a total of 750 ha of seed stands were marked as an interim source of better seeds until seed orchards are sufficiently productive. KFRI has selected 50 plus trees from various plantations in Kerala and established 3 pilot seed orchards. As the first phase of the planned genetic improvement of teak in Kerala is partly completed, the future scheme of work is discussed.

0915 Indira, E.P; Chacko, K.C; Krishnankutty, C.N. 1996. **Growth performance of teak nursery stock from genetically better sources for developing improved plantation technology**. KFRI Research Report 102: 49p. Kerala Forest Research Institute, Peechi.

The present study was undertaken to suggest methods to improve the nursery technology. The project also envisaged to estimate the mean number of plantable stumps per bed in teak nurseries in Kerala and to suggest an easy and indestructive plantability criterion. Performance of thirty one teak nurseries located in different parts of Kerala has been analysed in detail with respect to total and plantable stumps.

0916 IUFRO. 1981. **Species and provenance trials**. Wood production in the neotropics via plantations. IUFRO MAB USDA Forest Service, IUFRO Working Group S1.07.09, Puerto Rico, 8-12 September 1980: 137-263.

Included papers on provenance trial of different species. A paper, Keogh, R.M. Teak (*Tectona grandis* Linn.f.): Provenances of the Caribbean, Central America, Venezuela and Colombia is also included.

0917 Jayasankar, S; Babu, L.C; Sudhakara, K; Kumar, P.D. 1999. **Evaluation of provenances for seedling attributes in teak (*Tectona grandis* Linn.f.)**. Silvae Genetica 48(3/4): 115-122.

A provenance trial in teak involving seven provenances from Kerala was conducted. Data were compiled on germination characteristics and seedling performance in the nursery, and also on root growth potential and field establishment using stumps. Analysis of variance demonstrated profound variation in seedling growth rates among the provenances.

0918 Jayasankar, S; Sudhakara, K; Babu, L.C. 2003. **Provenance variation in growth, physiology, anatomical characteristics and foliar nutrient status of teak (*Tectona grandis*) seedlings**. Journal of Tropical Forest Science 15(1): 37-50.

Teak seedlings representing seven provenances from Kerala were examined for their differences in characteristics. Data were collected on growth attributes, physiological and anatomical parameters and foliar nutrient status of the seedlings. Large variations among provenances were observed in growth characteristics such as dry weight of stem, leaf and root and specific leaf area.

0919 Jones, N. 1968. **Plant breeding: Problems with forest tree species in West Africa**. Report from Ghana Journal of Agricultural Science, Accra 1(1): 21-28.

An account of the work carried in Nigeria and Ghana on six indigenous species and four exotic species including *Tectona grandis* is given. The problems of choosing species for study and selecting elite trees are discussed. Difficulties regarding the collection and transport of scion material are described. Grafting techniques are discussed.

0920 Jones, N. 1969. **The relationship between the form and value of some tree species in West Africa**. 2nd FAO/IUFRO World Consultation on Forest Tree Breeding, Washington FO-FTB-69-3/6: p12.

The species chosen in Ghana and Nigeria for selection of provisional plus-trees are listed which include the exotic trees, *Tectona grandis* and *Cedrela odorata*. Typical defects of form are described.

0921 Kadambi, K. 1945. **Teak-seed origin experiments in Mysore**. Indian Forester 71: 265-269.

It has long been observed by forest officers in Mysore that teak seed from the Kahankote district of Mysore, when used in plantations, produces stunted, relatively low, branchy trees with a relatively large number of insect galls. Trees of this origin are also more susceptible to defoliator attack, shed their leaves earlier, and sprout later. A study of the influence of teak seed provenance was studied and the results are analysed.

0922 Kedharnath, S. 1980. **Genetic improvement of forest trees**. Second Forestry Conference, Dehra Dun.

0923 Kedharnath, S. 1982. **Plus tree selection - a tool in forest tree improvement**. Improvement of Forest Biomass. P.K. Khosla, Ed.

0924 Kedharnath, S. 1985. **Breeding for insect resistance in forest trees**. Dr. T.V. Ramakrishna Ayyar Centenary Memorial Lecture, Loyola College, Madras 5.

0925 Kedharnath, S; Chetty, C.K.R; Rawat, M.S. 1969. **Estimation of genetic parameters in teak (*Tectona grandis*) without raising progeny**. Indian Forester 95(4): 238-245.

A method developed for coconuts was tested on teak. Genetic correlation of girth and number of internodes was found. It was shown that, in a small compact area of teak raised from seed, the environmental component of variation is negligible.

0926 Kedharnath, S; Mathews, J.D. 1962. **Improvement of teak by selection and breeding**. Indian Forester 88(4): 277-284.

A long-term programme for the improvement of teak by selection and breeding has been taken up by the Forest Research Institute, Dehra Dun with the object of producing superior varieties for growth on dry, semi-moist and moist teak forest types. The programme is described in stages, those of selection, propagation, testing, and finally production of seed and plants of the improved varieties.

0927 Kedharnath, S; Rawat, M.S; Chauhan, V.S. 1970. **Early growth performance of twenty clones of teak (*Tectona grandis* Linn.f.) in a seed orchard**. Proceedings of the Seminar-cum-Workshop on Genetic Improvement of Forest Seed in India, Dehra Dun: 86-89.

Clone seed orchard established in the New Forest, Dehra Dun were observed for studying growth of scion, number of internodes on the leader and average internodal length. The clones from Orissa, Madhya Pradesh and Mysore are observed to be outstanding in the three characters observed. Clones with more internodal and maximum internodal length are observed to be more vigorous.

0928 Keiding, A.H; Kjaer, E.D. 1998. **Teak - A tree with great potential**. (Danish). DST Dansk Skovbrugs Tidsskrift 83(4): 125-140.

A review is presented of the planting, growing and use of *Tectona grandis* in Thailand. Topics discussed include cooperative studies between Thailand and Denmark, vegetative propagation methods, work of the Teak Improvement Centre, international provenance testing, isoenzyme studies, genetic resource evaluation and prospects for the future.

0929 Keiding, H. 1972. **Seed orchards of *Hevea* and teak**. Forest tree improvement. 4. Symposium on seed orchards in honour of C. Syrach Larsen, Denmark, 7-8 October 1968: 107-123. Copenhagen, Akademisk Forlag, Denmark.

Selection work in seed orchards of teak is surveyed, reference being made mainly to studies carried out in Thailand.

0930 Keiding, H; Boonkird, S; Bryndum, K. 1966. **Aim and prospects of teak breeding in Thailand (II) Flowering of teak. (III) The germination of teak**. Natural History Bulletin of the Siam Society 21(1/2): 45-62; 69-73; 75-86.

Describes the programme of work for the Thai/Danish Teak Improvement Centre, Thailand. Gives a short account of the flowering habit of teak in relation to its effect on branching and height growth. Discusses the slow and sporadic germination of teak seed, and gives results of nursery experiments showing that the germination rate can be increased considerably by removing the exocarp from the fruit.

0931 Keiding, H; Jones, N; Webb, D. 1964. **A programme of tree breeding for Nigeria**.

Commonwealth Forestry Review 43(4): 319-326.

Describes the programme for the improvement, protection and establishment of seed orchards for four exotic and five indigenous species including teak. Budding and grafting have been reported successful for *Tectona grandis*.

0932 Keiding, H; Kemp, R.H. 1978. **Exploration, collection and investigation of gene resources: Tropical pines and teak**. Third World Consultation on Forest Tree Breeding, Canberra, Australia, 21-26 March 1977, v 1: 13-31. CSIRO, Australia.

Several hundred field trials have been established in over 40 countries and differences in growth rates and form have been found between provenances in species including teak. Several problems in exploration and collection of seeds and solutions are dealt with.

0933 Keiding, H; Lauridsen, E.B; Wellendorf, H. 1984. **Evaluation of a series of teak and Gmelina provenance trials**. Danida Forest Seed Centre, Denmark, Technical Note 15: 42p.

Tectona grandis and *Gmelina arborea* provenance trials in SE Asia and Africa were assessed. The development of an assessment procedure suited to the special features of broadleaved species is described.

0934 Keiding, H; Lauridsen, E.B. 1989. **Utilizing the results of international trials of teak and Gmelina**. Breeding Tropical Trees: Population structure and genetic improvement strategies in clonal and seedling forestry. Proceedings of the IUFRO Conference, Thailand, November 1998: p474. Oxford Forestry Institute, Oxford and Winrock International, Virginia.

Assessed the provenance trials of teak at the age of 9-10 years. The contribution with seed to the scheme by the Government of Thailand, India, Indonesia, Laos, Philippines, Ivory Coast, Togo, Nigeria, Tanzania, Malawi, Sri Lanka and Brazil are assessed.

0935 Keiding, H; Wellendorf, H; Lauridsen, E.B. 1986. **Evaluation of an international series of teak provenance trials**. 81p. Danida Forest Seed Centre, Humlebaek, Denmark.

An assessment was made of provenance trials in Papua New Guinea, Thailand, India, Brazil, Nigeria, Ghana, Ivory Coast, Mexico and St. Croix, W. Indies. Performances of provenance regions are tabulated for four plantation/breeding zones.

0936 Kerala Forest Research Institute, Peechi. 1982. **How to establish seed orchards of teak**. (Malayalam; English). KFRI Information Bulletin 5: 10p. Kerala Forest Research Institute, Peechi.

Based on work in Kerala where seed orchards have been established by grafting scions from plus trees. This bulletin covers the following topics; selection of plus trees and progeny testing, collection of scionwood, grafting methods, layout designs and spacing, cost of teak orchard establishment and the gain expected.

0937 Kertadikara, A.W.S; Prat, D. 1995. **Gene diversity study based on isozyme analysis in teak (*Tectona grandis* Linn.f.) provenances**. Proceedings of IUFRO Symposium of Measuring and Monitoring Biodiversity in Tropical and Temperate Forests, Bogor, 27 August-2 September, 1994. T.J.B. Boyle; B. Boontawee, Eds.

0938 Khemnark, B. 1964. **Teak improvement for Thailand**. Student Thesis, Faculty of Forestry, School of Forest Resources, University of Georgia, Athens, Georgia, Thesis 1969: 38p.

The proposed programme of Thai Danish Teak Improvement Centre is discussed. Study programmes include teak variation, selection of individual trees, clonal tests, provenance tests, progeny tests, seed sources and seed production areas, seed orchards, breeding program and heritability studies.

0939 Khemnark, C; Boonkird, S. 1963. **A preliminary study of different races of teak**. (Thai). Proceedings of the 3rd Agricultural Conference, Kasetsart University, Bangkok.

0940 Kittinanda, S.P. 1967. **Forest seed and tree improvement in Thailand**. Proceedings of Seminar on Forest Seed and Tree Improvement, Thailand: 22-26. Teak Improvement Centre, Ngao.

The present situation is reviewed on forest tree seed and tree improvement and future programmes indicated.

0941 Kittinanda, S.P. 1967. **Teak provenance trials**. (Thai). Proceedings of Seminar on Forest Seed and Tree Improvement, Thailand: 5p. Teak Improvement Centre, Ngao.

0942 Kittinanda, S.P. 1968. **Forest seed and tree improvement in Thailand**. Royal Forest Department, Bangkok R.109: 81p.

0943 Kittinanda, S.P. 1968. **Teak improvement research**. Proceedings of the seventh National Conference on Agricultural Sciences in Plants and Biology, Kasetsart University, Bangkok.

0944 Kittinanda, S.P. 1972. **Forest tree improvement plans in Thailand**. Proceedings of the Joint Symposia for Forest Tree Breeding of Genetics subject group IUFRO and Section 5, Forest Trees, SABRO, Tokyo, Japan 1972 B-7 (v): 4p. Government Forest Experiment Station, Japan.

The work of the Teak Improvement Centre and Pine projects were reviewed and the work done, includes establishment of seed source areas and seed orchards, selection of plus trees, vegetative propagation, provenance trials, clonal studies and control pollination. Emphasis to be laid on future plans is also given.

0945 Kittinanda, S.P. 1973. **Some problems in the production of improved forest tree-seeds in Thailand**. Proceedings of IUFRO Seed Symposium, Bergen, Norway, 4-14 September 1973, 33, Vol.2.

The importance of provenance research was stressed. The floral biology of teak is discussed and plantations of older than fifteen years are used for seed collection. Seed orchards under process of establishment may yield 100 kg per ha. when 15 years old. Establishment of seed center is recommended.

0946 Kjaer, E.D; Apichart Kaosa ard; Suangtho, V. 2000. **Domestication of teak through tree improvement: Options, potential gains and critical factors**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 161-190. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

The role of tree improvement for teak plantations is discussed with emphasis on possible gains and the key factors to be considered for successful tree improvement.

0947 Kjaer, E.D; Foster, G.S. 1996. **The economics of tree improvement of teak: (*Tectona grandis* Linn.f.)**. Danida Forest Seed Centre. Technical Note 43: 23p. DANIDA Forest Seed Centre, Denmark.

This paper discusses the economics of improving the genetic quality of teak through forest tree improvement. The paper is considered as a guide to the evaluation of the economics of genetic improvement of teak in country.

0948 Kjaer, E.D; Lauridsen, E.B; Wellendorf, H. 1995. **Second evaluation of an international series of teak provenance trials**. Danida Forest Seed Centre, Denmark: 118p.

This report presents the findings from the second evaluation of an international series of teak provenance trials. Seventy five seed provenances were sampled within eight zones: Moist India, semi moist India, dry India, Laos, Thailand and Indonesia plus landraces from Africa and Latin America. Eight of the original twenty one trials were reassessed to examine the development of the provenances and to ascertain whether the conclusions and recommendations resulting from the first evaluation were still valid. The data from all the eight evaluated trials is analyzed to examine the amount of interaction between trial regions.

0949 Kjaer, E.D; Lauridsen, E.B. 1996. **Results from a second evaluation of DFSC coordinated teak (*Tectona grandis*) provenance trials: Has new information been obtained?** Tree improvement for sustainable tropical forestry. QFRI IUFRO Conference, Queensland, 27 October-1 November 1996. Volume 1: 154-157. M.J. Dieters; A.C. Matheson; D.G. Nikles; C.E. Harwood; S.M. Walker, Eds. Queensland Forestry Research Institute, Australia .

A series of 48 provenance trials of teak were established by a number of countries during 1973-1976 as an international effort, initiated by the FAO Panel of Experts on Forest Genetic Resources, and co-ordinated by the Danida Forest Seed Centre. Eight trials have been assessed twice around age 9 and again at age 17 years, as a combined effort between trial host countries and the Danida Forest Seed Centre. Results are compared from the two evaluations.

0950 Kjaer, E.D; Siegismund, H.R. 1996. **Allozyme diversity in two Tanzanian and two Nicaraguan landraces of teak (*Tectona grandis* Linn.f.)**. Forest Genetics 3(1): 45-52.

Allozyme diversity was evaluated for two Tanzanian and two Nicaraguan landraces of teak and compared to the variation of four stands from within the natural distribution area as reference. It is thought that the genetic variation in the Tanzanian landraces has been enhanced following provenance hybridization, whereas the diversity in the Nicaraguan landraces may have been reduced because of bottlenecks. The allozyme diversity was found to be lower in the two Nicaraguan populations than in two Tanzanian.

0951 Konig, A; Venegas Tovar, L. 1981. **Forestry investigation and industrial development project, Colombia. Genetic improvement of forest trees**. FAO Report COL-74-005 Documento de Trabajo 33: 231p.

Preliminary results are presented of studies on timber species of the humid tropical and premontane humid forest zones in Colombia. The study includes species and provenance trials, progeny studies, studies on vegetative propagation, by cuttings or by grafting, phenological studies and establishment of seed crop stands.

0952 Kotwal, P.C. 1978. **Quantitative theory for the selection of superior phenotypes of forest tree species**. Journal of the Indian Botanical Society 57 Supplement 78.

Twenty external characters of teak were quantified for use in the selection of plus trees from which to establish clonal seed orchards producing high quality seeds. The grading system and its application are explained. This will help unbiased selection of plus trees and the maintenance of minimum selection standards.

0953 Kotwal, P.C. 1983. **Selection of superior phenotypes of teak in Madhya Pradesh**. Indian Journal of Forestry 6(1): 1-4.

Twenty external characters are identified as suitable for selection of plus trees for raising clonal seed orchards. These include height, girth, length of clear bole, stem form of buttressing, twisting, taper etc., epicormic branching, pest and disease susceptibility and seed production. The characters are graded 1-5 and descriptions of each grade are given in a table. Use of the grading system for selection of plus trees is briefly described.

0954 Krishna Murthy, A.V.R.G. 1997. **Teak improvement in Andhra Pradesh - its present status**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 171-174. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Seventy five plus trees of teak were selected and registered in 13 Forest Divisions of the State. A germplasm bank covering all the 75 plus trees was established in 4 different localities and about 65 plus seed production trees covering an area of 540 ha in 6 Forest Circles were selected, registered, and upgraded. There are 92 seed collection areas covering 6000 ha and about 2.5 lakhs of trees are available for seed collection.

0955 Kuang, B.C; Zhen, S.Z; Luo, M.X; Lin, M.P. 1996. **Evaluation of aggregate genetic value of main characters of provenances of teak**. (Chinese). Forest Research 9(1): 7-14.

Nine characteristics, describing the growth, quality and viability of teak provenances from India, Thailand and Nigeria were evaluated. The results show that there were significant or highly significant differences among provenances in all characteristics except survival rate. The relation between juvenile and mature teak trees indicates that it is possible to select superior trees at the seedling stage.

0956 Kuang, B; Zheng, S. 1992. **Genetic improvement of teak (*Tectona grandis*) in China**. Teak in Asia. Proceedings of the China/ESCAP/FAO Regional Seminar on Research and Development of Teak, Guangzhou, China, 19-27 March 1991, Technical Document GCP/RAS/134/ASB. FAO, Bangkok: 93-100. FORSPA Publication.

The authors report that Indian population is very complex in quantitative and qualitative characters; provenances from Mysore southwards have special leaf structure and strong drought/rust resistance and grow well in south Hainan province but a provenance from Maharashtra showed the worst growth and rust resistance ability. No significant differences in morphological structure were noted with provenances from Thailand.

0957 Kumar, A. 1992. **Teak seed improvement - achievements and problems**. Indian Forester 118(8): 525-533.

An account is given of the methods used and results obtained by the Maharashtra Teak Seed Improvement Programme. Seed orchards covering 166.5 ha have been raised after standardization of the method of vegetative propagation.

0958 Kumar, A. 1997. **Teak seed orchards in Maharashtra - some observations**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 160-164. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

At the Maharashtra Van Sanshodhan Sanstha, Chandrapur, an assemblage of 235 teak clones collected from 12 different States has been developed. Bud grafting of teak stumps has been employed. About 450 ha of good teak stands in natural forests have been identified for seed collection. Observations on flowering, fruiting and seeding of different clones and problems of management of teak seed orchards are highlighted.

0959 Kumar, A; Gogate, M.G; Sharma, R; Mandal, A.K. 1997. **Genetic evaluation of teak clones of Allapalli region, Maharashtra**. Indian Forester 123(3): 187-189.

A progeny test was carried out with teak in Chandrapur, Maharashtra, using seedlings raised from open pollinated seeds from clonal seed orchards. Observation on genetic variation indicated significant genetic variation at the family level. Height recorded both high heritability and genetic gain values. It is suggested that these clones can be used in breeding as well as in the production of advance generation populations in teak.

0960 Kumar, V; Kotrange, H.R; Dhotekar, U.P. 1998. **Genetic improvement of teak**. Indian Forester 124(9): 687-695.

A brief account is given of the teak genetic improvement programme of Maharashtra Van Sanshodhan Sanstha, Chandrapur, an organization set up in 1968 by the Maharashtra Forest Department. Aspects of the work described are the systematic selection of seed production areas, selection of plus trees, the establishment of clonal seed and seedling orchards, a national germplasm bank, and bud multiplication gardens, progeny testing and provenance trials.

0961 Kushalappa, K.A. 1986. **Tree improvement works in Karnataka**. Myforest 22(4): 201-210.

Tree improvement works include plus tree selection of different trees including *Tectona grandis*, teak germ plasm banks and seed orchards. *T. grandis* seed has been collected from eight selected plantations.

0962 Laurie, M.V. 1938. **Branching and seed origin in Coorg teak plantations**. Indian Forester 64(10): 596-600.

Four different types of branching seen in Coorg Teak plantations are described and illustrated and its herditary factors is discussed. It appears that varieties arising from seeds from dry localities may have considerably exaggerated characteristics when raised in damper and more favourable conditions. The necessity for ascertaining that the seed comes from a good origin when making Teak plantations is emphasized.

0963 Laurie, M.V; Sen Gupta, J.N. 1941 . **The importance of seed origin. Summary of results to date of the All-India Co-operative Teak Seed Origin Investigation**. Proceedings of the 5th silvicultural Conference, Dehra Dun, 1939: 103-121.

In the first paper details are given of the characteristics of 24 species of Indian trees exhibiting individual and racial variation in the timber, growth form hardiness, yield of oil, resin or other minor products, etc. The second paper discusses and summarizes the results of an investigation on the influence of the origin of seed of *Tectona grandis* on plant development and the characteristics of the crop raised.

0964 Loekito, D. 1959. **Selection of teak. III. Growth after 25 years**. Communication of Forest Research Institute, Bogor 70: 39p.

Results after 25 years of a provenance trial of nine foreign and nine Indonesian provenances laid out in 1932 are reported. The study in 1958 showed that, among the foreign provenances, Malabar and Indo-China teak had best height and girth, and Siam Teak the best stem form, with only slight branching. Indonesian provenances gave good results.

0965 Lokmal, N. 1995. **A note on the establishment of a clonal seed orchard of *Tectona grandis***. Journal of Tropical Forest Science 7(3): 510-512.

The establishment of a clonal seed orchard of 37 plus trees is described on a 1.6 ha site at Bukit Forest Reserve, Peninsular Malaysia. Bud sticks of the selected trees were collected, bagged, and sent in an ice pack to Pulau Langkawi, where they were grafted in the field onto rootstocks raised from 6-month-old potted seedlings. Initial budding success was about 70 percent and the number of ramets per clone was 1-10.

0966 Luckins, C. Babu; Gopikumar, K; Vijayakumar, N.K. 1997. **Genetic improvement of teak (*Tectona grandis*) for Peninsular India**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 143-148. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

The paper highlights the present status of genetic improvement in teak and gives a brief account on various regeneration techniques. The paper discusses on how to start a breeding programme in teak by selecting plus trees from base population representing different agro-climatic zones, seeds collection, progeny test, establishment of first generation clonal orchard, preparation of grafts, etc. The phase II of the programme includes forming a breeding population and making crosses among the best parents.

0967 Madoffe, S.S; Chamshama, S.A.O. 1989. **Tree improvement activities in Tanzania**. Commonwealth Forestry Review 68(2): 101-107.

At present there are about 78 000 ha of exotic plantations in Tanzania including *Tectona grandis*. Tree improvement activities aimed at survival, growth and stem form are briefly reviewed under the headings: species trials and arboreta, provenance testing, progeny testing, seed stands, production seed orchards and plus trees and clone banks.

0968 Madoffe, S.S; Maghembe, J.A. 1988. **Performance of teak (*Tectona grandis* Linn.f.) provenances seventeen years after planting at Longuza, Tanzania**. Silvae Genetica 37(5/6): 175-178.

The provenance trial, comprising seed sources from Tanzania, India, Java, New Britain, Nigeria, Sudan, Trinidad and Vietnam was established. Analysis of variance of data compiled on survival, growth and stem characteristics over 17 years demonstrated fairly uniform survival and growth rates among provenances. It is recommended that selection for tree improvement be made from superior trees of all the provenances in order to maintain a broad genetic base for teak in Tanzania.

0969 Mahapatra, P. 1970. **Establishment of seed production areas for teak, *Casuarina* and *Eucalyptus***. Proceedings of Seminar-cum-Workshop on Genetic Improvement of Forest Tree Seed in India, Dehra Dun: 75-79.

Describes the criteria followed in selection of teak seed production areas consequent to large scale teak plantations undertaken in Maharashtra state.

0970 Mandal, A.K; Lal, R.B; Gupta, B.N. 1998. **An improved method for selection of seed stands for conversion into seed production areas**. Indian Forester 124(11): 918-924.

This paper describes a suitable method for the selection and treatment of candidate seed stands of teak. The steps include selection of stands in different ecoclimatic zones of the state/country, selection of the best areas within the selected stands and selection of trees for retention/culling in the candidate seed stands.

0971 Mandal, A.K; Rambabu, N. 2000. **Quantitative genetic aspects of teak improvement**. Genetics and Silviculture of teak. International Book Distributors, Dehra Dun. A.K. Mandal; S.A. Ansari, Eds.

0972 Mandal, A.K; Sharma, R; Gupta, B.N. 1997. **Establishment and management of seed production areas**. TFRI Publication 5: 14p. Tropical Forest Research Institute, Jabalpur.

0973 Mathauda, G.S. 1954. **The all-India teak seed origin sample plots**. Indian Forester 80(1): 10-23.

The sample plots were laid out in 1930. Local seed is likely to give good results but may not prove to be the best. Of imported seed, that from dry localities is usually inferior to that from moist.

0974 Meekaew, P. 1992. **Genetic variation of growth, seed production and foliar nutrients of teak**. M.Sc Thesis. Kasetsart University, Bangkok.

0975 Mitarini, D; Harahap, R.M.S. 1994. **Differences between teak stands of clonal origin and seed origin in Saradan**. (Indonesian). Duta Rimba 20(173/174): 11-14.

Comparative growth data are given for a 41-yr-old clonal stand of teak and a seed origin stand. Total height and diameter were similar in the two stands, but bole height was greater in the clonal stand, while basal area, total volume and clear bole volume were more in the seed origin stand.

0976 Mkilanya, P.M. 1978. **Local provenance trials in Tanzania**. Progress and problems of genetic improvement of tropical forest trees.

Proceedings of a joint workshop, IUFRO working parties S2.02-08 and S2.03-01, Brisbane, 1977. V. Provenance trials and breeding programmes. G. Other softwood species: 850-856. Commonwealth Forestry Institute, Oxford.

Trial plantings of various tree species have been made since 1967 and details are given of the eleven most promising species including teak.

0977 Mukewar, A.M. 1997. **Accelerated breeding strategy for tree improvement and quality seed production of teak in India**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 149-153. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Discussed the general importance of tree improvement and illustrated the cost benefit ratio of tree improvement. Dealt with occurrence of teak, early breeding work and present status of teak improvement in India. Stressed the efficacy of accelerated tree breeding method with due emphasis on flowering of teak, flowering stimulus, floral biology and possible use of precocious flowering teak mutant in reducing the interval between breeding cycles and also for mass production of quality seeds in seed orchards.

0978 Muniswami, K.P. 1978. **Population improvement and hybridization - teak**. World Consultation on Forest Tree Breeding, Canberra, Australia, 3rd, 21-26 March 1977. v. 2: 507-544. CSIRO, Canberra.

Teak improvement through exploitation of ecotypic variation, selection and demarcation of seed production areas and selection of plus trees and establishing clonal orchards is discussed. A method of surveying and delineating promising provenances is suggested.

0979 Murillo, O. 1992. **Methodology for the design and establishment of seed stands**. Tecnologia en Marcha 11: Numero Especial: 3-13.

An account of the objectives and minimum criteria for seed stands and the stages in the process of selecting and establishing seed stands of *Tectona grandis* and *Bombacopsis quinatum* in Costa Rica is given.

0980 Nagarajan, B; Varghese, M; Nicodemus, A; Sasidharan, K.R; Bennet, S.S.R; Kannan, C.S. 1996. **Reproductive biology of teak and its implication in tree improvement**. Tree improvement for sustainable tropical forestry. QFRI IUFRO Conference, Queensland, Australia, 27 October-1 November 1996. Volume 1: 244-248. M.J. Dieters; A.C. Matheson; D.G. Nikles; C.E. Harwood; S.M. Walker, Eds. Queensland Forestry Research Institute, Australia.

One serious problem encountered in teak improvement programmes is low seed production in breeding plantations. Floral characteristics and seeding parameters of four teak clones in a germplasm bank from Central India and a clonal seed orchard in Southern India were studied. The clones differed in flower production per inflorescence, fruit set, fruit diameter and weight and in percentage of seed filled between locations.

0981 Nicodemus, A; Nagarajan, B; Mandal, A.K; Subramanian, K. 2000. **Genetic improvement of teak in India**. Proceedings of the 3rd Regional Seminar on Teak - Potentials an Opportunities in Marketing and Trade of Plantation Teak: Challenge for new Millennium, Yogyakarta: 277-294. Hardiyanto, E.D, Ed.

0982 Nicodemus, A; Nagarajan, B; Narayanan, C; Varghese, M; Subramanian, K. 2003. **RAPD variation in Indian teak populations and its implications for breeding and conservation**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Genetic variation in teak populations from Western Ghats and central regions of India were studied using Random Amplified Polymorphic DNA (RAPD) markers. The Western Ghats populations had more diversity compared to those from Central India. Partitioning of genetic diversity into within and between population showed that seventy eight percent of variation existing within populations and the rest between populations. A negative relationship is observed between latitude and within population diversity.

0983 Norwati, A; Abdullah, R; Norlia, B; Rosli, H.M. 2001. **Direct DNA transfer into teak (*Tectona grandis*) cells via microprojectile bombardment**. Tropical forestry research in the new millennium: Meeting demands and challenges. Proceedings of the International Conference on Forestry and Forest Products Research, 1-3 October 2001, Kuala Lumpur: 539-541. Forest Research Institute Malaysia, Kuala Lumpur, Malaysia.

0984 Nuthan, D. 2000. **Genetic variability and productive potentiality of teak (*Tectona grandis* Linn.f.) across different provenances in Karnataka**. Ph.D Thesis: 199p. Forest Research Institute, Deemed University, Dehra Dun.

0985 Odeyinde, M.A. 1974. **Lightning damage in a teak seed orchard at Onigambari**. Obeche 10: 105-107.

Records a lightning strike that occurred in July 1973 in a 9-year-old *Tectona grandis* seed orchard at Gambari, Nigeria, affecting a group of 9 trees covering an area of 0.34 ha.

0986 Oduwaiye, E.A. 1983. **An analysis of experimental data on the establishment of clonal seed orchards of three exotic forest tree species through vegetative propagation**. Thesis Summary. Forestry Abstracts 44(10): p607.

Including Tectona grandis.

0987 Ojo, G.O.A. 1974. **Thoughts on tree improvement programmes for some savanna plantation species**. Federal Department of Forest Research, Nigeria, Savanna. Research Paper 35: 4p.

The possibilities are discussed of improving several species including teak in savanna planting in Nigeria.

0988 Oka, A.G. 1986. **Genetic resources for teak plantations in Maharashtra States**. Regional Meeting of Silviculturist and Research Workers of Central Zone: 37-52.

0989 Omoyiola, B. 1974. **Comparison of four Nigerian teak seed sources**. Forest Series, Federal Department of Forest Research, Nigeria, Research Paper 23: 10p.

Trials of four provenances of *Tectona grandis* were established at three sites in the Benin area of Nigeria. No significant differences were noted between the seed sources in survival, total and mean base area of tree at any of the sites. But there were significant differences between sites for survival and for total and mean base area of the young trees.

0990 Palupi, E.R; Owens, J.N. 1996. **Reproductive biology of teak (*Tectona grandis* Linn.f.) in east Java, Indonesia**. Tree improvement for sustainable tropical forestry. QFRI IUFRO Conference, Queensland, Australia, 27 October-1 November 1996. Volume 1: 255-260. M.J. Dieters; A.C. Matheson; D.G. Nikles; C.E. Harwood; S.M. Walker, Eds. Queensland Forestry Research Institute, Australia.

Reproductive biology of teak in a clonal seed orchard in East Java, Indonesia was investigated and causes of low fruit and seed set were identified. Fruit maturation in relation to low fruit germinability was studied. The major cause of seed abortion was reported as failure of endosperm development which may result from a higher incidence of self-pollination.

0991 Palupi, E.R; Owens, J.N. 1998. **Reproductive phenology and reproductive success of teak (*Tectona grandis* Linn.f.)**. International Journal of Plant Sciences 159(5): 833-842.

Three clones, with low, medium and high fruit production capacities were selected from a 10-year-old clonal seed orchard and the reproductive phenology and reproductive success of the clones were determined. The low fruit production capacity of clone was reported of early flowering, while the high fruit production capacity of clone is reported coincided with the peak flowering period. The major constraints in teak reproduction were reported as low fruit and seed set.

0992 Pan, Y.F; Kuang, B.C; Liu, W.M. 1999. **Test of acid and aluminium-tolerance of teak clones**. (Chinese). Forest Research 12(2): 152-159.

Drought resistant, acid tolerant and fast growing teak trees were selected from six provenances of the countries India, Nigeria and China and tested for acid and aluminium tolerance of the trees and the results are presented.

0993 Paosujja, R. 1971. **Teak seed orchard in Thailand**. (Thai). Proceedings of the Second Forestry Conference, Royal Forest Department, Bangkok R.129: 37-44.

The teak seed orchard work in Thailand, its progress and problems encountered are presented and discussed.

0994 Parthiban, K.T; Surendran, C; Paramathma, M; Sasikumar, K. 2003. **Molecular characterization of teak seed sources using RAPDs**. International Conference on Quality

Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Teak seed sources from 30 locations (28 from India and one each from Lao PDR and Bangladesh) were characterized using RAPD's with 17 primers. Jaccard's similarity index revealed that a highest genetic distance of 0.457 was observed between Kerala III and Uttaranchal. The resultant phenotic tree indicated that the populations from each state were found to be grouped within the same sub-clusters barring a few seed sources revealing the identity of each population.

0995 Perera, W.R.H. 1961. **Teak seed orchards. Stage 1-plus trees and perfection of a bud-grafting technique**. Ceylon Forester 5(1/2): 6-16.

Describes experiments with two methods of grafting-the forkert and the `T' or shield budding method. Covering the bud-patch with a piece of leaf before tying gave improved results.

0996 Persson, A. 1971. **Observations from a progeny trial of *Tectona grandis* Linn.f. at Longuza, Tanga region, Tanzania**. Silviculture Research Note, Tanzania 24: 11p.

Describes trials of progenies obtained by open pollination of 28 mother trees in three plantations in Tanzania. Significant differences between progenies in base area and degree of fluting, and significant differences in height were noted after four years of planting. Methods of improving the genetic quality of the *T. grandis* planting stock used in Tanzania are discussed.

0997 Persson, A. 1971. **Observations from a provenance trial of *Tectona grandis* Linn.f. at Longuza, Tanga region, Tanzania**. Silviculture Research Note 22: 13p.

0998 Pinyopusarek, K; Keiding, H. 1981. **Proposal for standardising assessments in international provenance trials of teak, *Tectona grandis* Linn.f**. DANIDA Forest Seed Centre, Circular Letter 15: 20p. DANIDA Forest Seed Centre, Denmark.

The authors tested a preliminary assessment procedure with regard to an example of an international teak provenance trial in Thailand and suggested it could have wider application in international coordinated teak provenance trials. Criteria selected related to the forestry view point and relate to habit and growth; may be modified to accommodate regional characteristics, but also to class differentiation within scorings.

0999 Piot, J. 1977. **Trial of ten *Tectona grandis* Linn.f. provenances in upper Volta**. Proceedings of the Joint IUFRO Workshop, Brisbane Vol.2: 758-788.

1000 Prachim Suksileung; Chuntanaparb, L; Choob Khemnark; Sutat Sriwatanaponge. 1975. **Clonal variation and inheritance in growth characteristics of teak (*Tectona grandis* Linn.f.)**. Kasetsart Journal 9(1): 1-11.

In sixteen clones in two clonal seed orchards studied for seed yield, diameter at breast height and height and found significant differences existed between clones for all characters at one locality. Heritability estimates for height were moderate and higher than those for diameter at breast height. Diameter at breast height was strongly correlated with height.

1001 Prawotosoedarmo, S. 1957. **Seed collection and seed gardens**. 2nd Session, FAO Teak Sub-Commission, Bandung, Indonesia FAO/TSC-57/26: 2p. FAO, Rome.

The studies of Eidmann on the influence of (a) time of collection, (b) age of mother stand, (c) size of seed on the germinative power of teak seed is described and his results are presented in the form of tables. A positive correlation is indicated between the germinative power and the growth in the first year.

1002 Purkayastha, S.K; Satyamurthi, K.R. 1975. **Relative importance of locality and seed origin in determining wood quality in teak**. Indian Forester 101(10): 606-607.

Analysis indicated that environmental influences had a much greater effect than seed source on the specific gravity of the wood and the growth rate of *Tectona grandis*.

1003 Rai, S.N; Parthasarathi, K. 1989. **Present status of forest tree improvement work in India**. Indian Forester 115(9): 603-612.

An outline is given of achievements and ongoing work in 13 states. The authors review the present status of tree improvement work and provide current information.

1004 Rao, P.S; Murali, V; Venkaiah, K; Murti, S.S.N. 2002. **Performance of teak (*Tectona** *grandis* **Linn.f.) clones of Andhra Pradesh**. Indian Forester 128(12): 1288-1294.

Performance of teak bud wood grafts taken from twenty seven plus trees, representing different Forest Divisions of Andhra Pradesh were evaluated for stand volume, PAI and MAI.

1005 Rao, P.S; Venkaiah, K; Murali, V; Murti, S.S.N; Sattar, S.A. 2001. **Evaluation of International teak provenance trial plot in North East Andhra Pradesh**. Indian Forester 127(4): 415-422.

The International Provenance Trial Plot sponsored by FAO/DANIDA in collaboration with the Andhra Pradesh Forest Department was established in 1973 at Maredumilli, North-East Andhra Pradesh with teak seeds from India, Africa and Thailand and one local seed source as control. Analysis of variance of data on 26-year-old trees indicated non-significant differences among provenances in terms of height, clear bole height, diameter at breast height and crown, while significant differences were observed for survival rate, straightness and roundness of stem and health characteristics. The indigenous seed source 'Konni' (Kerala) and exotic source 'Ban Mae Pan' (Thailand) were found the best in all parameters studied.

1006 Rawat, M.S; Uniyal, D.P; Emmanuel, C.J.S.K. 1995. **Use of coppice shoots in seed production areas of teak: A new concept**. Indian Forester 121(6): 469-471.

The creation of seed production areas is an important interim step in the tree improvement programmes to enable the supply of superior seed for afforestation until seed orchards become fully productive. This paper suggests a new method which utilizes the coppicing capacity of teak. Coppiced/pollarded shoots flower and fruit abnormally early.

1007 Rawat, M.S; Uniyal, D.P; Sharma, S.L. 1998. **Identification of provenances based on leaf morphology in *Tectona grandis***. Indian Forester 124(4): 248-251.

Data on leaf morphological parameters are tabulated for 21 teak provenances from South and South East Asia grown from seed in the nursery at the Forest Research Institute, Dehra Dun. A study of these revealed certain diagnostic characters in plants 2 yr old, on the basis of which different provenances/sources could easily be identified.

1008 Resende, M.D.V de. 2001. **Workshop on the improvement of forest trees and palms in Brazil, Curitiba, 9-10 August 2001**. Documentos Embrapa Florestas 62: p245. Embrapa Florestas, Colombo, Brazil.

1009 Rimbawanto, A. 1995. **Tree breeding strategy for genetic improvement of *Tectona grandis* in Indonesia**. Duta Rimba 20(181/182): 13-19.

1010 Rimbawanto, A. 1998. **Application of DNA techniques in the improvement programme for teak (*Tectona grandis* Linn.f.) in Indonesia**. (Indonesian). Duta Rimba 23(212): 15-20.

1011 Sagreiya, K.P. 1962. **Orchard versus Naturalistic silviculture**. Proceedings of 5th World Forest Congress, Seatle, 1960. 1: 454-457.

Gives a description of mixed teak forests of Madhya Pradesh which are distinguished into three types; moist, semi-moist and dry types. The paper describes the condition of regeneration of teak and suggests how maximum yield of teak can be obtained by thinnings and silviculture.

1012 Sandiford, M. 1990. **An account of the identification of existing *Tectona grandis* populations in Solomon Islands. A first step toward the improvement of *Tectona grandis***. Forestry Division, Solomon Islands, Forest Research Note 61-01-90: 14p. Forestry Division, Honiara, Solomon Islands.

1013 Sekaran, S; Sasidharan, K.R; Nicodemus, A; Bachpai, V.K.W; Narayanan, C; Venkatasubramanian, N; Singh, B.G; Siddappa. 1999. **Criteria for establishment of seed production areas of teak, *Eucalyptus* and acacias**. National Symposium on Forestry towards 21st Century, Coimbatore.

1014 Sen Gupta, J.N. 1939. **The importance of the seed origin (Part II)**. Proceedings of 5th Silvicultural Conference, Dehra Dun Item 4: 109-120.

Discusses the results of an investigation on the influence of the origin of *Tectona grandis* seed on plant development and on the characteristics of the crop raised. For case of establishment and early development it seems that seed of local origin is superior to that of distant origin. Included is a key to the morphological differences in races of teak based on leaf characters.

1015 Sharma, R; Mandal, A.K; Gupta, B.N; Jattan, S.S. 1996. **Progeny test in teak**. Indian Forester 122(3): 229-234.

The present status of knowledge on different genetic parameters such as variation, heritability and genetic gain, intercharacter relationships, and selection of the best general combiners is reviewed using the data on diameter, height and basal area growth from 4 progeny trials established in 1978-92, three in Maharashtra and one in Orissa.

1016 Sharma, R; Swain, D; Mandal, A.K. 2000. **Estimates of genetic parameters from an open pollinated genetic test of teak (*Tectona grandis*)**. Journal of Tropical Forest Science 12(1): 44-48.

Genetic parameters were estimated from a 7-yr-old open pollinated progeny test of teak in Orissa which used seeds from a clonal seed orchard established in Orissa using plus trees from 6 provenances from Orissa. The results indicated presence of significant genetic variation in the material studied. Height, diameter and basal area were found to be under the control of additive gene action. Basal area and diameter exhibited positive significant genetic correlation.

1017 Sharma, S.L; Rawat, M.S. 1998. **Genetic improvement of teak (*Tectona grandis*) in Forest Research Institute: An overview**. Indian Forester 124(8): 633-636.

A brief overview is given of tree breeding studies undertaken with teak in Indian Forest Research Institute at Dehra Dun, Uttar Pradesh.

1018 Singh, J.S. 1962. **The effect of planting teak of different seed origins on Gangetic alluvium**. Tropical Ecology 3(1/2): 119-138.

Presents data on growth performance in relation to the translocation and use of minerals in plantations. Growth of N. Burma provenance is found the best, followed by S. Burma, S. Bombay, Madhya Pradesh and N. Bombay. Leaf litter and soil analyses showed that the faster growing trees affect the mineral economy of the soil by increasing the mineral circulation and by the quantities of minerals removed when the trees are harvested or the litter removed.

1019 Singh, N.B; Beniwal, B.S. 1993. **Evaluation of teak germplasm**. Journal of Economic and Taxonomic Botany 17(2): 462-464.

Teak germplasm from 130 Indian genotypes was grafted onto local teak stumps at Chessa, Arunachal Pradesh and assessed for 10 characters - graft sprouting/incompatibility/survival, straightness, girth, crown form, height, disease and pest resistance, and flowering and fruiting.

1020 Sinha, A; Prasad, K.G. 2003. **Status and strategies for teak improvement in North East India**. Indian Forester 129(9): 1132-1140.

Presented the status of teak in North East India and discussed the variability in teak plantations and the strategies for their improvement.

1021 Soerianegara, I. 1971. **Forest tree improvement in Indonesia**. Rimba Indonesia 16(1/2): 11-19.

Reviews the progress of provenance trials of *Tectona grandis* in West, central and E. Java from 1930 onwards.

1022 Suangtho, V; Graudal, L; Kjaer, E.D. 1999. **Genecological zonation as a tool in conservation of genetic resources of teak (*Tectona grandis*) in Thailand**. International Teak Conference, Teak Beyond 2000, Chiang Mai, Thailand, 23-25 August 1999; Danida Forest Seed Centre, Humlebaek, Denmark: 8p.

1023 Subramanian, K.N. 1997. **Genetic improvement of teak in India**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 135-142. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

The main purpose of the breeding programme is to develop genetically upgraded planting material, suitable for growing in different ecoclimatic zones. Seed orchard is the permanent source of production of genetically improved seeds in desired quantity to improve the quality of plantations. 1000 ha of clonal seed orchards has been established in India. Teak can be vegetatively propagated by rooting, branch cutting, grafting, etc.

1024 Subramanian, K.N; Nicodemus, A; Radhamani, A. 1994. **Teak improvement in India**. Forest Genetic Resources 22: 33-36.

A brief account is given covering seed production areas, provenance trials, plus tree selection, seed orchards, progeny testing, vegetative propagation including tissue culture and future strategies for *Tectona grandis* in India.

1025 Sumantakul, V. 2002. **Forest genetic resources in Thailand**. Proceedings of the South-East Asian moving workshop on conservation, management and utilization of forest genetic resources, Thailand, 25 February - 10 March 2001. J. Koskela; S. Appanah; A.P. Pedersen; M.D. Markopoulos, Eds. FORSPA Publication 31: 93-104. FAO Regional Office for Asia and the Pacific, Bangkok, Thailand.

This paper describes the forest types and forest plantations of Thailand. Tree improvement activities began in 1965 with teak. The lists of priority species for conservation, tree improvement or seed procurement are provided.

1026 Sumantakul, V; Yingransiri, T. 1979. **Progeny test of teak (*Tectona grandis* Linn.f.) in diallel crosses**. (Thai). Report on Silviculture 1977-1978: p84. Royal Forest Department, Ministry of Agriculture and Cooperatives, Bangkok.

1027 Sumantakul, V; Yingransiri, T. 1979. **Provenance trial of teak at Amphoe Ngao, Lampang**. (Thai). Report on Silviculture 1977-1978. Ministry of Agriculture and Cooperatives, Bangkok, Royal Forest Department, Silviculture Division: 66-73.

1028 Suri, S.K. 1984. **Analytical study of teak provenance tests in North Raipur Division of Madhya Pradesh**. Indian Forester 110(4): 345-363.

Teak plantations were raised using seeds from Maharashtra, Burma, Kerala, Madhya Pradesh and Karnataka. Mean values of the growth parameters up to 50 yr old and results of statistical analysis are tabulated. Teak seeds from moist localities are shown to be bigger than those from dry zones. Germination and plant percent appear to depend on the quality of the seed rather than the size and weight. The height appears to be a function of site quality rather than seed origin.

1029 Tanskley, S.D; Mc-Couch, S.R. 1997. **Seed banks and molecular maps: Unlocking genetic potential from the wild**. Science 277: 1063-1066.

1030 Teak Improvement Centre, Ngao. 1965. **Teak improvement centre - Mac Huat teak plantations**. Progredds Report 4: 3p. Teak Improvement Centre, Ngao.

The first report after launching the joint collaboration project in 1965. The progress made and experiments undertaken on vegetative propagation of teak by bud grafting, establishment of a multiplication garden, observations on clonal collections, generative propagation, and flowering and controlled pollination were reported.

1031 Vaclav, E. 1972. **Provenance trials in Tanzania**. Vaclav, E: Seed stands and plus trees in Tanzania. Silvaecultura Tropica et Subtropica 2: 87-101.

Summarizes and evaluates the results of provenance trials established up to 1966 with *Pinus elliottii*, *P. radiata*, *P. taeda*, *Tectona grandis* and *Cupressus* spp.

1032 Vaclav, E. 1972. **Progeny trials in Tanzania**. Vaclav, E: Seed stands and plus trees in Tanzania. Silvaecultura Tropica et Subtropica 2: 69-86.

Evaluates the results of progeny trials of plus-trees established in Tanzania up to 1967 for different species including *Tectona grandis*.

1033 Vakshasya, R.K; Uniyal, D.P; Rawat, M.S. 1988. **Teak plus trees for specific traits**. Indian Forester 114(3): 168-169.

Different types of plus tree selection are reported here. The first is a tree with wavy grain from a wet zone in Kerala. Trees with less straight grain reported as occurring in the dry zone.

1034 Valera, L; Garay, V; Dulhoste, R. 2001. **Variation in teak plantations (*Tectona grandis* Linn.f.) in the Ticoporo Forest Reserve, Venezuela. Basis for an improvement program**. (Spanish). Revista Forestal Venezolana 45(2): 145-152.

Morphological variation of teak was determined from 24-25 years old plantations established with seed from Trinidad. Stands with silvicultural thinning and with genetic thinning were there. Each tree was evaluated taking stem and crown morphology, as well as quantitative traits of diameter and height. Selected trees were evaluated using phenotypic criteria.

1035 Varghese, M; Nicodemus, A; Nagarajan, B. 2003. **Fertility variation and dynamics of two clonal seed orchards of teak**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Fertility differences between clones were estimated in two 25 year old clonal seed orchards of teak in South India.

1036 Vasudeva, R; Gunaga, R; Hanumantha, M. 2003. **Implications of clonal variation in reproductive traits to improvement of teak (*Tectona grandis* Linn.f.)**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Estimated inter and intra clonal variation for reproductive traits in a 20 year old clonal seed orchards in Karnataka. Inter clonal variation was significant for majority of fecundity and phenological traits suggesting a strong genetic control. Strong provenance effect of phenology was observed.

1037 Venkataraman, K.G. 1973. **Importance of seed origin in provenance research in teak (*Tectona grandis*)**. Forestry Conference (Silvicultural Conference) 6-10 December 1973, 61. Forest Research Institute, Dehra Dun.

The nature of variation within a species are demonstrated and evaluated by growing sample from the entire ranges of the species, in-adequately replicated experiment in one or more location. This forms the basis of seed source trial.

1038 Venkatesh, C.S; Koshy, M.P; Chacko, K.C; Indira, E.P. 1986. **Genetic improvement of teak (*Tectona grandis* Linn.f.) in Kerala**. KFRI Research Report 13: 21p. Kerala Forest Research Institute, Peechi.

Results of the project undertaken with the objective of selection of seed stands and plus trees and establishment of pilot seed orchards are presented. Plantations superior in vigour and growth compared to adjoining areas were selected and converted to seed production areas. Fifty trees, outstanding in growth and stem form designated as plus trees have been selected in different teak growing areas in Kerala using check tree method.

1039 Vivekanandan, K. 1975. **The present status of tree improvement work in Sri Lanka**. Sri Lanka Forester 12(2): 95-100.

Breeding and provenance trials are performed with teak (*Tectona grandis*), *Eucalyptus* and tropical Pinus species.

1040 Vivekanandan, K. 1977. **First year results of the teak provenance trials in Sri Lanka**. Sri Lanka Forester 13(1/2): 31-33.

1041 Watanabe, A; Widyatmoko, A; Rimbawanto, A; Shiraishi, S. 2004. **Discrimination of teak (*Tectona grandis*) plus trees using selected random amplified polymorphic DNA (RAPD) markers**. Journal of Tropical Forest Science 16(1): 17-24.

To achieve a highly reliable clone management of teak plus trees, useful DNA molecular markers were surveyed using RAPD analysis and their ability to discriminate among plus tree clones was examined. Evaluation of the discriminatory powers of the fragments suggested that the selected RAPD markers would be useful in the clone management of teak plus trees.

1042 Wellendorf, H; Apichart Kaosa ard. 1988. **Teak improvement strategy in Thailand**. Forest Tree Improvement, Arboretet Horsholm, Denmark 21: 43p.

The key elements of a tree improvement strategy are outlined. Extension of seed production areas; establishment of regional seed centres and nurseries, the Teak Improvement Center, Royal Forest Department of Thailand, to guarantee the source of collected seed, consolidation of the seed orchard areas with a broader clonal input, initiation of long-term breeding populations in order to maintain the capability for steady genetic improvement in future generations and flexibility to respond to changing breeding objectives.

1043 White, T. 1967. **A conceptual framework for the tree improvement programmes**. Martinus Nijhoff Publishers, Dordrecht.

1044 Wirjodarmodjo, H; Soebroto, P.M. 1983. **Teak improvement by Perum Perhutani**. Duta Rimba 9(63/64): 3-13.

1045 Wyatt Smith, J. 1961. **Provenance and progeny trials of teak in North-West Malaya**. Malaysian Forester 24(2): 126-141.

Germination percentage and height development in the nursery of selected teak seed of local and foreign origin are described. Early height and girth development in plantation of selected stump plants from the seedlings raised are noted.

1046 Yingransiri, T. 1980. **A review on genetic improvement of teak**. Vanasarn 37(1): 35-40.

A review of work at the Forest Research Institute, Dehra Dun, the Thai-Danish Teak Improvement Centre, Thailand and the FAO/Danish Forest Tree Seed Centre, Denmark. Additional work has also been carried out in Tanzania, Nigeria, Malaysia, Indonesia and Papua New Guinea.

1047 Zhang, R.G; Lan, M; Qiao, G.M; Wang, Y.G; Xie, X.R. 1999. **Provenance test on growth evaluation of teak in Honghe**. (Chinese). Forest Research 12(2): 190-196.

Remarkable differences in height and diameter at breast height were noted among provenances. Based on selection criteria of 10 percent over the standard provenance for diameter at breast height and 40 percent over for volume, eight provenances were considered fine.

1048 Zobel, B.J; Dorman, K.W; Arnason, A; Benedikz, T; Turnbull, J.W; Pitcher, J. 1973. **Forest genetic resources information - No. 2**. FAO Forestry Occasional Paper 2: 66p.

Contains several papers on forest genetics including a paper on the collection of *Tectona grandis* and *Pinus merkusii* seed by the Seed Centre, Humlebaek, Denmark.

Go top

Ecology and Distribution

1049 **Teak in Travancore**. Indian Forester 18, 1892: 385-386.

Leaf differences in teak are reported due to age. Young leaves are scabrous, serrate and obovate or even spatulate and after 5-6 months become glabrous and ovate and darker-coloured. Also describes methods best suited for raising teak plantations in the area. In moisture climate seed burnt by grass-fires gives good results and in dry areas, sowing seed in contour lines and digging up soil under seedling trees helps.

1050 **Teak in Burma**. Indian Forester 36(3), 1910: 126-132.

More uniform system for teak combined with improvement fellings, based on Burma experience and on the aim and object of the method of working teak forests and methods of regeneration to be adopted are discussed.

1051 **Teak in Burma**. Indian Forester 36(11/12), 1910: 672-675.

The problem of yield and exploitation in the Burma improvement felling system are discussed with reference to natural regeneration of teak forests in Burma - with special reference to training labour for improvement fellings.

1052 **Teak in Trinidad**. Indian Forester 43(3), 1917: 161-162.

Tracing back the earlier introductions of teak in Trinidad to 1913 it was observed that best results were obtained in Central Reserve plantations. Seed source was Burma. Areas of teak planted, methods of planting and growth data under exotic conditions were also noted.

1053 ***Tectona grandis* (aspects of forestry in Indonesia)**. (Dutch). Tectona 43(3), 1955: 158-235.

The final issue of Tectona includes a series of general papers as well as the paper teak forests (W.A. Zijp).

1054 **Special issue on problems of the ecology of tropical forests**. Holz Aktuell 3, 1981: 96p .

Various aspects of the ecological problems of tropical forests are discussed. And also included a paper on teak. Burma: Its forests and teak timber. How it was possible to export wood for over 100 years without exhausting supplies: 62-65.

1055 **Forest ecosystems of the world**, 1992: 214p. Rawat Publications, Jaipur.

An examination of various aspects of forest ecosystems in different parts of the world in the context of the large-scale destruction and degradation of forests that is taking place worldwide. And also included a chapter on Teak [*Tectona grandis*] forests of India (Dube, R.S; Soni, P): 66-80.

1056 Altona, T. 1922. **The teak forests (*Tectona grandis* L.f.) in the Bismarck-Archipelago**. (Indonesian; English). Tectona 15: 862-869.

Discussed the pure teak forests in the midst of the mixed non-teak, local climate and soil not preferred by teak, supports that teak must have been imported to Bismarck-

Arhipelago. The origin is traced to colonist Hindoos.

1057 Altona, T. 1923. **Teak and Hindoos-Origin of *Tectona grandis* Linn.f. in Java**. (Indonesian; English). Tectona 16: 237-263.

Many teak forests in Java has been proved to be old plantations and that could not be proved to have been planted. These old forests were planted by Hindoos. The frequency of old teak plantations and the absence of virgin forests make it very improbable that the teak tree is native.

1058 Altona, T. 1926. **Teak and Hindoos-the legend of Adji-Saka**. (Indonesian; English). Tectona 19: 939-1011.

Evidence is presented to support the presumption teak tree has been imported and cultivated on the island of Java, Folklore and Vernacular names-'Tree from Java' suggest and confirm the import of teak in Boetom and Moena islands.

1059 Apichart Kaosa ard. 1981. **Teak (*Tectona grandis* Linn.f.) - its natural distribution and related factors**. Natural History Bulletin of the Siam Society 19: 55-74.

1060 Aung, D.U. 1956 . **Problem of invasive evergreen forests**. Proceedings of the 8th Silvicultural Conference, Dehra Dun, 1951, Part 2: 252-253.

Describes the development of Burmese moist deciduous teak-bearing forest to evergreen forest- a natural process accelerated by fire exclusion and selective teak working.

1061 Bhatt, R.P; Bedi, S.J; Sabnis, S.D. 1971. **Botanical exploration of the Gora range of the Rajpipla forests, Gujarat State**. Indian Forester 97(8): 477-486.

Lists 460 species found during three years of study. The vegetation is classified as mixed dry deciduous forest. *Tectona grandis* is the most important tree.

1062 Branca, A. 1960. **First experimental results of the introduction of forest tree species into Italian Somaliland 1954-1958**. Riv. Agric. Subtrop. Trop., Firenze 54(416-7/9): 652-660.

Short notes are included on teak and other species.

1063 Brandis, D. 1903. **Teak in evergreen forests**. Indian Forester 29(5): p187.

Describes teak in evergreen forests in Attaran, Burma, after an inspection tour with reference to and after reading Mr. Bruce's account of the patch of teak in moist evergreen forest in Ruby mines district and Mr. Ohver's remarks on it.

1064 Brascamp, E.H.B. 1915. **The teak in Rosengan**. (Dutch). Tectona 8: 73-74.

1065 Brascamp, E.H.B. 1916. **Teak in residency of Bantam**. Tectona 9: 707-709.

1066 Brascamp, E.H.B. 1921. **Teak and no Hindoos**. Tectona 14(8): 137-140.

Gives the origin of Tectona planting in Java which is attributed to Hindoos who imported the species into the area.

1067 Brascamp, E.H.B. 1922. **History of spreading of teak in Java in 1693, in Kolonial Archief No. XXXVIII**. Tectona 15: 951-959.

1068 Britto, S.J; Soosairaj, S; Arockiasamy, D.I. 2002. **Comparative analysis of distribution of tree species in two plots of one hectare in Srirangam Island of the river Cauvery**. Advances in Plant Sciences 15(1): 79-84.

The diversity, density and abundance of tree species 30 cm girth at breast height were investigated. Dominant species include teak.

1069 Bruinsma, A.E.J. 1916. **About the presence of teak forest in West-Java during East India Company**. (Indonesian; English). Tectona 9: 655-665.

1070 Canning, F. 1931. **Teak in the United Provinces**. Indian Forester 57(1): 4-5.

The author disagrees on the financial possibilities of introduction of teak in a sal predominant province. Even though, earlier plantations are successful, the author claims the policy of not replacing sal by teak, as success of teak introduced in gaps in sal forest is doubtful as no observations are made on teak growth till maturity.

1071 Carthaus, E. 1909. **Is teak originally native to the Malay Archipelago?** (German). Tectona 2: 309-319.

1072 Champion, H.G. 1938. **A preliminary survey of the forest types of India and Burma**. Indian Forest Records (n.s) Silviculture 1(1), 1936.

A classification of forest types based on four temperature zones, each sub-divided on available moisture reflected by the relative

importance of evergreen, deciduous and thorny trees.

1073 Champion, H.G; Seth, S.K. 1968. **A revised survey of the forest types of India**. Government of India Press, Delhi: p404.

Includes an account of teak forest types under Moist Deciduous and Dry Deciduous types. *Tectona grandis* has been mentioned to occur as a characteristic species in the following types: South Indian moist deciduous very moist teak forests; South Indian moist deciduous slightly moist teak forest; Southern tropical dry deciduous very dry teak forest; Southern tropical dry deciduous dry teak forest.

1074 Chandrasekharan, C. 1962. **Forest types of Kerala state**. Indian Forester 88(9, 10, 11 and 12).

Includes an account of the forest types with detailed floristics including teak types.

1075 Chhetri, H.B; Rai, B; Basu, P.K. 1995. **Phytosociology and standing crop biomass of three different forest types of Namthang-Narak region (South Sikkim) under Teesta sub-catchment area**. Environment and Ecology 13(2): 304-308.

The results are reported of a phytosociological study made in three forest types in South Sikkim: natural tropical moist semi-evergreen forest, *Tectona grandis* plantation at 720 m altitude with 4200 tree stems/ha and *Shorea robusta* plantation.

1076 Chollet, A. 1967. **Teak in Africa**. Teak sub-Commission, FAO, Rome FO:T-67/3: 9p.

The origin of teak in Africa is described and the countries from where the species has been introduced have been listed indicating the areas covered. References of teak to climate and soil, tending operations required, diseases to which it is subjected are indicated. New developments in silvicultural treatment particularly as regards thinning and length of rotation are noted. The future potential of this species is summed up.

1077 Deb, D.B. 1960. **Forest type studies in Manipur**. Indian Forester 86(2): 94-111.

This is the first attempt to identify and classify forest types in this region. The main climatic zones with their respective formations are described which include *Tectona/Dipterocarpus* forests.

1078 Devois, J. 1959. **The teak (*Tectona grandis*) in tropical French Africa**. Cashiers des Ingen Agronomy 133: 9-14.

Deals with *Tectona grandis* on resources, culture and uses.

1079 Devoto, F.E. 1942. **Teak**. (Spanish). Mundo Maderero 3(25): 5-7.

Tectona grandis was introduced by the author to Argentine in 1929. Ten-year-old trees grown in the Satta province from seed obtained in British India have shown good growth and have fruited from the age of six years.

1080 Dubreuil, J. 1961. **The introduction of exotic species into Togo**. Proceedings of the 2nd Conference of Forestry Inter-African Countries, Pointe Noire, 1958 Vol. 2: 515-522.

Gives results of experiments with different exotic species including *Tectona grandis*. Teak was first introduced by the Germans at the beginning of the century.

1081 Forest Department, Sri Lanka. 1921. **Attempts to grow teak in Ceylon**. Government Publication, Ceylon: 15p. Forest Department, Sri Lanka.

1082 Forest Department, Tongo. 1960. **Forestry in Tongo**. Forest Advances Newsletter, Colonial Office, London: 8 Appendix A(1). Forest Department, Tongo.

Tongo's 27000 acres of forest, the bulk of which is on the island of Eua. Teak has recently been introduced on an experimental basis.

1083 Forest Department, Thailand. 1962. **Types of forests of Thailand**. Ministry of Agriculture, Bangkok R.44: 12p. Forest Department, Thailand.

Describes teak forests occurring predominantly in mixed deciduous forests in Northern Thailand.

1084 Forest Research Institute, Dehra Dun. 1923. **Ecology of teak**. Report of Forest Research Institute, Dehra Dun: 40p.

1085 Ganapathy, P.M. 1962. **Arborescent exotics in the forestry of Andaman Islands**. Golden Jubilee Souvenir 1912-1962, Southern Forest Rangers College, Coimbatore: 114-123.

Sketches the history, development and present status of exotics in Andaman Islands, where exotics, chiefly teak, are being substituted for the indigenous deciduous and semi-evergreen species.

1086 Ganeshaiah, K.N; Shaanker, R.U; Bawa, K.S (Editors). 2001. **Tropical forests: Structure,**

diversity and function - part B. Tree diversity and phenology. Tropical ecosystem: Structure, diversity and human welfare. Proceedings of the International Conference on Tropical Ecosystems: Structure, Diversity and Human Welfare, Bangalore, 15-18 July 2001: 737-777. Science Publishers, Enfield.

Out of ten papers one paper was on ecological adaptations and population structure in *Tectona grandis* in relation to seed production and tree breeding.

1087 Gent, J.R.P. 1927. ***Tectona grandis* in the Gold Coast**. Empire Forestry Journal 6: p292.

1088 Hertling, J.C.von. 1879. **Notes on *Tectona grandis* in Java**. Forstw Cbl 23: 486-490.

1089 Hewetson, C.E. 1941. **Observations on the ecology of *Tectona grandis* in the Central Provinces**. Indian Forester 67: 617-629.

The main points of the ecology of teak in the Central Provinces are discussed and suggestions are made for establishment of teak in this area.

1090 Hewetson, C.E. 1951. **Ecology of *Tectona grandis***. Madras Forest College Magazine 27(3): 101-108.

1091 Higo, Y. 1961. **On the introduction of forest tree species in the Meiji era**. (Japanese; English). Bulletin of the Faculty of Agriculture, Kagoshima University 10: 42-67.

Lists the species experimentally introduced from 1868 to 1912 with their Latin names and references to Japanese literature. Teak, eucalypts and *Albizia lebbek* are recommended for Formosa.

1092 Ilorkar, V.M; Khatri, P.K. 2003. **Phytosociological study of Navegaon National Park (Maharashtra)**. Indian Forester 129(3): 377-387.

The measurement of different phytosociological attributes like density, basal area, importance value index, nature of vegetation, distribution pattern and resource utilization of woody vegetation was conducted in the forest of Navegaon National Park in Maharashtra. *Tectona grandis* was the dominant species in the area.

1093 Indian Botanical Society, Baroda. 1955. **Symposium on vegetation types of India, 2-3 January 1955**. Indian Botanical Society, Baroda: 17p.

Gives abstracts of twenty eight papers, mostly dealing with the general vegetation of different areas, including discussions on the ecology of sal and teak and the ecological status of grasslands.

1094 Jackson, J.K. 1960. **The introduction of exotic trees into the Sudan**. Sudan Silva 10(1): 14-30.

Includes notes on teak.

1095 Kermani, W.A. 1951. **Exotic trees in East Pakistan**. Pakistan Journal of Forestry 1(3): 273-279.

Noted the performance of different exotic trees including *Tectona grandis*.

1096 Koppen, Karl van. 2003. **Transformation of tropical forestry starts with teak**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

It is argued that transformation of tropical forestry starts only with teak by discussing new dimensions of the giant leap towards global thinking, new limitations for the human behaviour, new issues of growing population and role of tropical forestry. New perspectives of tropical forestry were further elaborated considering teak as the flagship of tropical hardwoods for throwing light on the potential of sustainable investments, today's practices and benefits from such investments.

1097 Kriek, W. 1970. **Report to the government of Uganda on performance of indigenous and exotic trees in species trials**. Technical Assistance Report FAO/TA-2826.

1098 Krishna Murthy, A.V.R.G. 1960. **Forest types of Andhra Pradesh: India**. AIFC, Diploma in Forestry. Forest Research Institute and College, Dehra Dun.

A general account is given of the forest types of Andhra Pradesh with notes on climate, geology, soils and detailed description of ecological relationships of the various forests types. The teak forests of the state under the dry deciduous and moist deciduous formations are described in detail with ecology and floristics.

1099 Kuruvilla, K. 1967. **Ecology of Dangs Forest (Gujarat)-I. Phytosociology of the forests in Ahwa block**. Indian Forester 93(10): 720-733.

The ecological studies of the forest include the study of the pattern of distribution of various forest communities in relation to factors of topography, soil, microclimate and biota and assessing their ecological status. *Tectona grandis* is the dominant species in all the stands examined.

1100 Lane, D.A. 1958. **The planting of exotic trees in Ghana**. Proceedings of the 2nd Conference, Inter-Africa, Pointe Noire, 1958, Vol.2: 421-435.

Deals with different species including *Tectona grandis* and lists a number of other species that have been tried.

1101 Lavrov, M.T. 1965. **Forests and animals of North Vietnam**. (Russian). Izdatel'stvo Lesnaja Promyslennost, Moscow: 133p.

A compilation of information on the forests and fauna of North Vietnam, based on extensive travels in the country and on Russian, French and Vietnamese literature. The main types of forest vegetation are described. The chapter on forestry and the forest industry covers forest areas and volumes, felling, transport, plantations including *Tectona grandis*, nurseries, tending, conversion, harmful and useful insects, insect pest control, fire protection and hunting.

1102 Ledoux, P. 1963 . ***Tectona grandis* introduced into Mazagao, Amapa, began to flower at the age of 9 years**. (French). Lecointea, Belem 1: 8p .

Reported the flowering of one of the three biggest trees out of approximately 30 had a diameter at breast height of approximately 50 cm. and the tallest was 12 m. high.

1103 Loetsch, F. 1958. **The teak forests of northern Thailand**. World Crops 10(1): 13-16.

The description of the author's mission, the forest types encountered, total stock of main species, drain and regeneration, development trends etc., stressing the dangers of illicit cutting and shifting cultivation.

1104 Mathur, C.M. 1959. **Teak forests in Rajasthan and their problems**. Proceedings of All-India Teak Study Tour and Symposium, December 1957-January 1958: 172-175. Forest Research Institute, Dehra Dun.

Describes teak in Rajasthan state under the heads: Distribution, topography, geology and soil, climate, types of forests, condition of present crop, regeneration, defoliation and thinnings.

1105 Mathur, C.M. 1960. **Forest types of Rajasthan**. Indian Forester 86(12): 734-739.

The important types are dry teak and *Anogeissus pendula* forest.

1106 Meher Homji, V.M. 1970. **Some phytogeographic aspects of Rajasthan, India**. Vegetation 21(4/6): 9299-9320.

Analyses the floristic elements in each vegetation type, concluding that the boundary of the dry deciduous teak forest type should be regarded as the demarcation line between the Indo-Malayan and the Perso-Arabian floras.

1107 Mello, H do Amaral. 1962. **Some aspects of the introduction of teak into Brazil**. UNCSAT Conference, United Nations, Geneva E/CONF.39/C/475: 3p.

Describes preliminary results of teak cultivation in Piracicaba. Information on its growth and nursery methods is provided.

1108 Mello, H do Amaral. 1963. **The introduction of teak into Brazil**. (Portuguese). An bras. Econ. flor., Inst. Nac. Pinho 15: 113-119.

Gives preliminary results of attempts to establish a teak plantation in Piracicaba.

1109 Mensbruge, G de la. 1958. **The introduction of *Tectona grandis* in the Ivory Coast**. Inter-African Forestry Conference, Pointe Noire, 1958: 12p.

General history and notes on climate, natural regeneration, enemies, height, diameter and volume increment, methods of treatment, site factors, methods of formation and their cost.

1110 Milward, R.C. 1930. **The introduction of teak in United Provinces**. Indian Forester 56(12): 545-547; 57(1): 3-4.

Offers the views on growth of teak and regeneration in United Provinces and compares it with sal and yield of first class timber from teak growing areas comparing it with that of Burma.

1111 Mirchandani, T.K. 1941. **Kanara forests**. Indian Forester 67: 62-67.

Forests cover nearly four-fifths of the Kanara District. There are three main forest types-the tropical rain forest, the teak-bearing, deciduous high forest and the deciduous pole forest. The management and products of these forests and methods of exploitation are discussed briefly.

1112 Misra, R (Ed). 1957. **Vegetation types of India: Summaries of papers of the Symposium, Indian Science Congress, 1955**. Journal of Indian Botanical Society 36(4): 587-605.

Includes a number of papers on the vegetation types of India which also include a paper entitled teak bearing forests of Madhya Pradesh.

1113 Nina Mindawati; Sukaesih Parajadinata. 1997. **Development prospects of Malabar teak in Indonesia**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 24-27. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Malabar teak, introduced from Nilambur, Kerala, has been planted since 1932 in different locations in Indonesia for studying the growth characteristics. It is found that Malabar teak grows better in height and girth than local teak. The seeds give highest germination percentage of 56.81 than those of other local and exotic provenances. Wood quality of 40 year-old vegetatively propagated and seed propagated Malabar teak is same as that of local teak.

1114 Nisbet, J. 1892. **Notes on teak in Burma**. Forstl. Naturw. Zeitschr 1: 437-439.

1115 Oever, H.Ten. 1916. **Teak forests in Java**. Tectona 9: 851-878; 723.

1116 Ogbe, G.A.E. 1960. **A study of the introduction of three exotic trees to the Western region of Nigeria: *Tectona grandis* Linn.f. (Teak), *Gmelina arborea* Roxb, *Pinus caribaea*, Morelet (Slash Pine)**. Imperial Forestry Institute, Oxford: 121p.

Details of silvicultural and economic potentialities of exotic timber species including teak are presented. The necessity for cultivating economic timbers of very short rotation that can be grown on soils not required for agriculture is stressed. The soils and climate of the region are discussed. Data are given of volume and yield tables and curves for height, espacement and number of trees per acre are given.

1117 Oliver, J.W. 1905. **Teak in evergreen forest**. Indian Forester 31(7): p417.

Reported a patch of teak noted in the evergreen forest with an undergrowth of evergreen trees, plantains and palms in the Mohnyin Reserve, Katha Division and the teak reproduction is not possible in such forests.

1118 Pandeya, S.C. 1954. **Ecology of teak (*Tectona grandis*)**. Perugia University studi. Facol. Di. Agricultural Annals 10: 239-241.

1119 Parde, J. 2002. **Teak, in tropical forests and plantations**. (French). Revue Forestiere Francaise 54(3): 253-258.

Brief review of recent important publications on teak, Bois et Forets des Tropiques, 261/262/263, 1999-2000; Unasylva 201(2), 2000 and three other French articles. It describes the geographical distribution of the species and its silvicultural characters.

1120 Pedroso, L.M. 1973. **Information on the present behaviour of exotic species in the region of the middle Amazon**. Sudam Documenta 5(1/4): 21-31.

Data are presented on species trials with various exotics including teak to provide information on the probable growth of these species in the middle and lower Amazon region.

1121 Peet, C. 1954. **Famous forests: *Tectona grandis* in Burma**. American Forester 60(6): 20-21, p40.

1122 Puri, G.S. 1951. **Advances in the ecology of teak (*Tectona grandis*) in India**. Proceedings of the 8th Silvicultural Conference, Dehra Dun, 5-14 December 1951, Part II: 242-250.

Discussed the relationship of teak with its environment and the importance of such studies in scientific management of teak forests and in extending plantations of teak.

1123 Rance, W; Monteuuis, O. 2004. **Teak in Tanzania: I. Overview of the context**. Bois et Forests des Tropiques 279: 5-10.

This paper reviews the status of the existing teak stands monitored by the Tanzanian National Tree Seed Programme, which set up the Kiroka teak clonal seed orchard in the rural district of Morogoro in 1996.

1124 Rasmihiran, W. 1956. **Teak forests**. Vanasarn 14(4): 12-25.

Describes the condition of an evergreen forest in North East Thailand which has deteriorated due to overexploitation and smuggling and recommends improving the same by planting with teak.

1125 Rittirangsrirot, Ch. 1968. **The structural characteristics of teak bearing mixed de-**

ciduous forest, Huay-Tak, Ngao, Lampang. (Thai). Student Thesis. Kasetsart University, Bangkok.

Soils of more than 60 cm. deep are more fertile except in places where sandy-clay loam and clay-loam soils are derived from parent material of limestone or shale. The upper layers are alkaline and lower below, the reaction is acidic in these soils. Average highest humidity 88.4 percent and lowest 36.9 percent.

1126 Rosevear, D.R. 1940. **Exotic trees in the Cameroons**. Nigerian Forester 1: 22-25.

Successfully acclimatized exotic species including teak.

1127 Ross, J.K; Moss, R.P. 1957 . **Exotic forest trees in the Western Region of Nigeria. Some notes on the soils of the Western Region with special reference to plantations of exotic trees**. Government Printer, Ibadan: 29p. Seventh British Commonwealth Forestry Conference, Australia and New Zealand, 1957.

Includes details on teak in the region.

1128 Schmulling. 1922. **Teak in Java**. Zeitschrift fur Forst. U-Jagdwesen 54: p760.

1129 Scott, C.W. 1946. **Forestry in Burma**. Journal of Oxford University Forestry Society 1: 24-34.

1130 Seth, S.K. 1960. **Progress report on teak forestry in India 1957/1959**. FAO Teak-Sub-Commission, Delhi FAO/TSC 60/2.4: 2p. FAO, Rome.

Reviews the progress of teak forestry in India and progress made under revision of teak yield tables, study of teak soils, foliar analysis of teak, phytosociological studies of teak forests, teak provenance trials, teak genetics, teak epidemiology, teak wood seasoning, chemistry of teak wood, composite wood tests with teak, and mechanical and physical properties of teak.

1131 Seth, S.K; Kaul, O.N. 1978. **Tropical forest ecosystems of India: The teak forests (as a case study of silviculture and management)**. Tropical Forest Ecosystems. A State of Knowledge Report, UNESCO/UNEP/FAO, UNESCO, Paris: 628-640.

Ecosystem functioning of the teak forests is discussed under the following headings. Flowering and seed production, seed origins and provenances, germinative capacity and establishment, seed dormancy and pre-treatment, biomass and productivity, water balance, nutrient cycling and protection. Its natural regeneration, regeneration techniques and management practices are also discussed.

1132 Seth, S.K; Khan, M.A.W; Gupta, A.C. 1959. **Proposed programme for physiologico-ecological studies on teak**. Proceedings of All India Teak Study Tour and Symposium, Dehra Dun, 1959: 138-141.

The paper outlines the methods suggested for carrying out physiologico-ecological research on teak by three agencies namely FRI, Dehra Dun, State Forest Departments and state silviculturist.

1133 Setten, G.G.K. 1960. **Progress report on teak forestry in Malaya 1957/1959**. Teak Sub-Commission, New Delhi FAO/TSC-60/2.6: 1p.

Progress report since the first session of TSC in 1956 at Bangkok and reports the small scale planting trials initiated at Kedah in N.W. Malaya, FAO teak provenance trials and wilt attack in teak nurseries causing causalities of the nursery seedlings are reported.

1134 Shah, S.A. 1994. **Ecological aspects of tropical forest management (the case of India)**. Indian Forester 120(11): 981-999.

An account of the history of the development of forest management in India and discusses the ecological impacts of the different phases, covering effects on soil, water, wildlife and agriculture. Planting failures of commercial timber species mostly teak and loss of species diversity in teak forests are discussed.

1135 Singh, P; Oommachan, M. 1991. **Distributional range of trees of Jabalpur Forest Division, M.P**. Indian Journal of Applied and Pure Biology 6(2): 133-138.

A systematic study was made of the tree species present in the dry tropical forests of Jabalpur Forest Division, Madhya Pradesh. Two type of forests are identified, northern tropical dry deciduous forest typified by sal and southern tropical dry deciduous forest typified by teak.

1136 Soest, G.H van. 1869. **Forestry in Java**. Journal of the Netherlands East Indies: 151p.

1137 Stebbing, E.P. **The forests of India**. Government of India Press, Calcutta III: p415.

Gives notes on teak in Vol.III, p415.

1138 Stebbing, E.P. 1948. **The teak forests of Burma**. Indian Forester 74: 1-4.

Discussed the history of Burmese forests and their exploitation from 1852-1947, with a warning on future Burmese responsibilities. The author mentions about the working plan drawn up for Burma forests and in 1938-39 alone 1.4 million cu.ft. of teak timber was cut from 200 mission acres of reserved forests.

1139 Streets, R.J. 1962. **Exotic forest trees in the British Commonwealth**. Clarendon Press, Oxford: 712-725p.

The species introduction in Ceylon, Australia, Fiji, Ghana, India, Andamans, Jamaica, Kenya, Nigeria, Malaya, North Borneo, Nyasaland, Siorre Leone, Solomon Islands, Southern Rhodesia, Tanganyika, Trinidad and Tobago, Uganda, etc. were described including a note on pests and diseases and growth and yields in some plantations.

1140 Teak Sub-Commission, Indonesia. 1957. **Reports on teak grown under exotic conditions**. Teak Sub-Commission, Bandung, Indonesia FAO/TSC-57/3: 98p.

Furnishes information on growing teak under exotic conditions in Africa: Lower Guinea, Casa manea, Ghana-Gold Coast, Ivory Coast, Kenya-East Africa; in Asia and the Pacific: Australia-Papua and New Guinea, Ceylon, Fiji, Ryukyu Islands, Taiwan and U.S. Pacific Islands; in India: U.P., West Bengal; and Vietnam and Central America: Cuba, Jamaica, Panama, Puerto Rico, Surinam and Trinidad.

1141 Teak Sub-Commission, Rome. 1967. **Trials of teak in North West Malaya**. Teak Sub-Commission, Rome: 12p.

Afforestation work aimed at providing high quality cabinet timber is described. The rate of growth is compared and problem of borer attack discussed. No significant variation in form, vigour etc. of the various provenances of teak tried has been observed. Further trials adequately replicated with special reference to resistance to borer attack recommended.

1142 TEAKNET. 1995. **Major teak resources of the Asia-Pacific region**. TEAKNET Newsletter 1: p7.

1143 Tewari, D.N. 1967. **Ecological studies in Indian forests-trend of natural succession under treatment and closure in forest of Madhya Pradesh**. Proceedings of the 11th Silvicultural Conference, Dehra Dun 1967. Forest Research Institute, Dehra Dun.

The main forest types in the state mainly teak and sal are subjected to a variety and degrees of biotic influences, like grazing, fires and cuttings etc. The response to these factors was studied under the above treatments and closures. Suggestions are made for the scientific management of Madhya Pradesh forests.

1144 Thomas, R. 1941. **Forests and forest exploitation in the Congo: Deforestation, erosion and reforestation**. Bulletin Agricole du Congo, Belge 32: 91-111p.

About 48 to 53.5 percent of Congo lands are wooded. The distribution of various forest areas is given along with floristics and composition of tropical types. Besides native species, teak along with many other species has been tried.

1145 Tuteja, S.C; Singh, V. 1980. **The botany of Shespur forest division of Madhya Pradesh. I. Geology and forest types**. Indian Journal of Forestry 3(1): 9-14.

Seven major forest types were recognized including very dry teak forests.

1146 Ugalde Arias, L.A; Martinez, H.H.A. 1989. **Location and description of experimental sites for the 14 most important species in the Madelena Project in Central America**. (Spanish). 62p. Centro Agronomico Tropical de Investigacion y Ensenanza, Turrialba, Costa Rica Centro Agronomico Tropical de Investigacion y Ensenanza, Turrialba, Costa Rica.

Species include *Tectona grandis*.

1147 Vidal, J. 1960. **The forests of Laos**. (Spanish). Bois et Forests des Tropiques 70: 5-21.

Distinguishes and describes the forest types including the teak forests of Laos.

1148 Weaver, P.L; Francis, J.K. 1988. **Growth of teak, mahogany and Spanish cedar on St. Croix, U.S. Virgin Islands**. Turrialba 38(4): 308-317.

Included the data regarding the growth performance of teak. Testing of six provenances of teak showed significant differences in diameter at breast height and height with the Tamil Nadu, India, provenance growing most rapidly but having the highest mortality.

1149 White, K.J. 1967. **Teak as an exotic plantation species in Territory of Papua and New Guinea**. FAO Teak Sub-Commission: 7p.

Giving areas of teak plantation in Papua and New Guinea as 2997 ac. with an annual future programme of 400 ac. Observations are made on site factors, stocking yield, seed supply and thinnings and tree improvement trials.

1150 Yadav, S.S; Shah, G.L. 1982. **Phytosociological studies on the vegetation of Dangs Forest in south Gujarat: An ordination study of fourteen localities**. Indian Journal of Forestry 5(4): 281-286.

Maturity indexes, community coefficients and ordination values are given for each locality in this forest dominated by *Tectona grandis*.

1151 Zizp, W.A. 1955. **Teak forests**. Tectona 43: 169-179.

1152 Zwart, W. 1927. **True and false Bladong forests**. Tectona 17.

Go top

Vegetation Ecology

1153 Meher Homji, V.M. 1977. **History of the dry deciduous forests of western and central India**. Ecology and archaeology of western India: 109-126. D.P. Agarwal; B.M. Pande, Eds. Concept Publishing, Delhi.

The dry deciduous forests of Gujarat and Rajasthan, India are divided into seven types which include dry deciduous teak forests.

1154 Meher Homji, V.M. 1988 . **Vegetation of South India**. Advances in Forestry Research in India 2: 199-210.

A brief description is given of the small-scale vegetation maps published by the French Institute in Pondicherry in collaboration with the Indian Council of Agricultural Research. Maps on the medium scale of 1: 250 000 have been published in cooperation with the Forest Departments of Karnataka and Kerala. A classification of the vegetation in southern India has been proposed, based on 'series'. Five series are described in the paper, and the descriptions include information on climate, soil and land use. The series include moist deciduous teak forest series forming an ecotone between the wet evergreen forest series and the dry deciduous teak forest series on the western side of the Western Ghats in Kerala, Goa and Maharashtra, and on the eastern fringe of the Western Ghats in Karnataka, extending to 1000 m altitude and the dry deciduous teak forest series. The history of Indian forest vegetation is briefly discussed.

1155 Pande, P.K. 2001. **Structures of the tropical dry deciduous teak (*Tectona grandis*) forest of Satpura Plateau with special emphasis on regeneration and disturbance**. Journal of Tropical Forest Science 13(2): 329-343.

Comparative quantitative structures such as vegetation composition, structure and diversity and regeneration behaviours of important tree species were analysed on three sites in the tropical dry deciduous teak forest of South Chindwara Division, Madhya Pradesh. Three communities were identified: (1) *Tectona grandis-Lagerstroemia parviflora-Sterculia urens*, (2) *T. grandis-Lannea coromandelica-Diospyros melanoxylon-Butea monosperma-Miliusa tomentosa* and (3) *T. grandis-Chloroxylon swietenia-Lagerstroemia parviflora-Diospyros melanoxylon*. Stand density, species richness, diversity index, dominance, tree, shrub and herb composition were studied.

1156 Pande, P.K; Bisht, A.P.S; Sharma, S.C. 1988. **Comparative vegetation analysis of some plantation ecosystems**. Indian Forester 114(7): 379-389.

Phytosociological data are discussed for four plantations including *Tectona grandis* at New Forest, Dehra Dun, Uttar Pradesh, studied by quadrate analysis. Tree density and species richness were highest in the older plantations. Total basal cover is reported of teak 2887.27 eucalypts 1106.88. Importance value index was highest for eucalypts and sal followed by teak and pine in their respective plantations.

1157 Pandit, B.R; Raviya, R.D. 2001. **Phytosociological study of Eastern Gir forest**. Flora and Fauna Jhansi 7(1): 35-36.

An ecological survey of Gir forest in Gujarat was made. *Tectona grandis* was one of the most important and distinct species in the forest.

1158 Pradeepkumar, G; Prathapasenan, G. 2001. **Tree diversity of Shoolpaneshwar Wildlife Sanctuary in Gujarat**. Indian Forester 127(11): 1207-1214.

A detailed survey of the trees of Shoolpaneshwar Wildlife Sanctuary, Gujarat was conducted. The prominent forest type was a mix dry deciduous dominated by *Tectona grandis*. The major threats to the natural vegetation and its components are presented.

1159 Prasad, R; Pandey, R.K. 1992. **An observation on plant diversity of sal and teak forests in relation to intensity of biotic impact at various distances from habitation in Madhya Pradesh: A case study**. Journal of Tropical Forestry 8(1): 62-83.

A study on the extent of biotic impacts on natural forests was conducted about 0.5-1 km from villages (site 1), about 5 km from villages (site II) and 5-10 km from villages (site III). Sets of sites were chosen in the sal forests of Mandla and Bilaspur districts and the teak forests of Seoni and Balaghat districts. Phytosociological characteristics, regeneration status and successional trends were studied in all the sites.

1160 Sai, V.S; Budholiya, S.S. 1986. **Niche measurement of tree species in a central India forest**. Tropical Ecology 27(1): 76-84.

Studies on niche measurement were conducted for tree species occurring at two forest sites, namely N. and S. facing slopes of the Chhuhiya hills on the Kymore range of the Vindhya mountains, Madhya Pradesh. Forest type was tropical dry deciduous dominated by *Tectona grandis* and *Shorea robusta*. Measurement of niche breadth and overlap based on species composition at different altitudes was made by absolute and resource weighting measurements.

1161 Santapau, H; Raizada, M.B. 1954. **Contributions to the flora of the Gir forest in Saurashtra**. Indian Forester 80(7): 379-389.

Teak is the main forest tree species which often becomes crooked due to maltreatment. Other species occurring are listed. New plantations of teak, semai, and maddi are coming up.

1162 Shah, G.L; Bhatt, R.G. 1980. **Phytosociology of the forests of Panchmahals district in eastern Gujarat**. Indian Journal of Forestry 3(1): 47-53.

Vegetation data are tabulated for 11 forest districts in the area, the dominant community includes Tectona. Data are compared with those from the neighboring Chhotaudepur Forest Division.

1163 Shah, G.L; Yadav, S.S; Parabia, M.H. 1978. **Phytosociological studies on the vegetation of Chhotaudepur forest division, Eastern Gujarat**. Indian Journal of Forestry 1(4): 312-318.

Frequency data of species are tabulated for five ranges and for the division as a whole. The dominant community includes *Tectona grandis* with an understorey of *Holarrhena antidysenterica*.

1164 Singh, J; George, M; Varghese, G. 1988. **Vegetation communities and interspecific association of the tree species in a tropical forest ecosystem of Western Ghats**. Journal of Tropical Forestry 4(3): 229-235.

Vegetation analysis of the Mudumalai wildlife sanctuary in Tamil Nadu shows *Terminalia tomentosa*/*Lagerstroemia microcarpa* (moist deciduous), *Tectona grandis* /*Anogeissus latifolia* (dry deciduous) and *A. latifolia/Acacia chundra* (dry deciduous). The communities were mapped and their distribution correlated with the rainfall pattern of Mudumalai Forest Division.

1165 Singh, V.P; Dagar, J.C; Upadhyaya, S.D. 1979. **Analysis of structure, production dynamics and successional trends of tropical grassland communities at Ujjain**. Sylvatrop 4(4): 231-254.

It is suggested that the grasslands represent a seral stage maintained by grazing, burning and harvesting and in the absence of these controls succession would occur to a dry deciduous forest dominated by Acacia spp., *Butea monosperma* and *Tectona grandis*.

1166 Smitinand, T. 1994 . **Measuring and monitoring biodiversity in tropical and temperate forests: Proceedings of a IUFRO Symposium, Chiang Mai, Thailand, 27 August-2 September 1994**. 395p. Center for International Forestry Research, Jakarta, Malaysia.

This book contains 24 papers selected from among those presented at the symposium. A paper on genetic diversity of *Tectona grandis* is also included.

Go top

Silviculture

(See also 0152)

1167 **Teak**. Indian Forester 8, 1882: 240-243.

A note on growing teak in Coorg and geographic distribution, locality factors, growth rates, and requirements of growth, seed germination and planting problems and experience gained in growing teak so far is given.

1168 **Autobiography of a teak tree: Extract from Madras Mail**. Indian Forester 17, 1891: 240-244.

Covers the silvicultural characteristics and uses of teak wood in a lighter vien.

1169 **Java teak**. Indian Forester 40(9), 1914: p468.

Teak forests in Java occupy 148,000 acre and every year 2.5 times area felled is regenerated. Sowings of *Leucaena glauca* in between rows keeps down Imperata grass and keeps soil clean, enriches the soil in humus and nitrogen and ultimately disappears with the increase of the forest cover.

1170 **Teak in Burma**. Indian Forester 40(9), 1914: 450-451.

Describing the silvicultural requirements of teak, the author advocates artificial sowing of teak in lines in mixture with Pyinkado or some other shade tree and reports that the present selection system is unsuitable for teak. Pure species groups are preferred to mixed groups and advocates stocking of bamboo flowered areas artificially. Two storied high forest systems and thinnings of plantations are recommended.

1171 **India: Resolutions passed at the Sixth Silvicultural and the Senior Officers' Conferences, Dehra Dun, April 1945**. Empire Forestry Journal 24(2), 1945: 214-220.

Resolutions were passed on post-war silvicultural research, the effect of war on silvicultural and yield prescriptions of working plans, the efficiency of enumerations, natural and artificial regeneration of teak, the afforestation of dry areas, grazing and pasture research.

1172 **Silvicultural research: Ceylon 1944**. Office of the Conservator of Forests, Colombo, Ceylon, 1946: 16p.

Teak sample plots of the Eastern division, which have a rank growth of *Imperata cylindrica* are subjected to annual ground fires which tend to increase erosion, and the Illuk itself has a markedly debilitating effect on the teak. These effects become more pronounced when thinnings are carried out in plantations which had previously been underthinned.

1173 **Recommendations of the all-India Teak study tour and symposium, December 1957-January 1958**. Indian Forester 84(10), 1958: 593-602.

Recommendations are made for the regeneration, tending and management of the different types of teak forest and plantation.

1174 **The silviculture of teak-Republic of Dahomey**. (French). Centre Technique Forestier Tropical Publication, 1969: 40p.

Gives an account of silviculture of teak in the Republic of Dahomey with a detailed description of soils and conditions favourable for teak plantations. Results of the analysis of soils and density and stocking of plantations raised during 1950-1968 are appended.

1175 Ali, S. 1970. **The silvics and silviculture of teak**. Pakistan Journal of Forestry 20(2): 163-169.

1176 Aung, T; Aung, H; Mon, A.A. 2001. **Variation in the quality-wise ratio of teak logs of export quality production during the last decade from 1990-91 to 1999-2000**. Academy of Agriculture, Forestry, Livestock and Fishery Sciences, Research Paper: 11-12.

1177 Becking, J.H. 1928. **Silviculture of teak in Java**. (Indonesian; English). Meded Proefsta Boschw 22.

Reports experiments set up to compare the value of crops raised from advance growth supplemented by sowing under girdled trees and some coppice, with plantations raised with field crops. The treatment is described and the results showed that there was little difference between the two crops as regards increment, but the plantation teak was said to be slightly of better form.

1178 Best, J.W. 1918. **Silviculture in the Central Provinces from the tax prayers' point of view**. Indian Forester 44(9): 401-409.

Some measurements of yield from teak forests of Hoshangabad Division are given.

1179 Brascamp, E.H.B. 1916. **The end of teak in Rosengan**. Tectona 9: p318.

1180 Chandrasekharan, C. 1959. ***Tectona grandis* recent research trends at Nilambur**. Proceedings of All India Study Tour and Symposium, December 1957-January 1958, Forest Research Institute, Dehra Dun, 1959: p189.

Deals with several aspects of research on teak specially a new disease in teak, incidence of teak defoliation, deterioration of site

quality in second rotation, thinning research experiments, under planting etc.

1181 Chaplin, G.E. 1993. **Silvicultural manual for the Solomon Islands**. ODA Forestry Series 1: 305p. Overseas Development Administration, London.

This manual provides silvicultural accounts for the 14 most important tree species including teak in the Solomon Islands together with summaries for quick reference. It is complemented by the five volumes of the management manual, which provides basic directives for day-to-day practices. Bibliographies with more than 300 references are included.

1182 Chollet, A; Samapudhi, K. 1967. **Teak Sub-Commission. Fourth Session, Rome, 17 October 1967. Provisional agenda**. FAO Report T-67-1-8: 45p.

A collection of papers including, History and achievements of the Teak Sub-Commission; Teak in Africa; Teak as an exotic plantation species; Production outlook for teak in Burma; Production outlook in the old teak-growing countries and Country report on teak forestry, Thailand.

1183 Coster, C. 1933. **The application of the biological sciences to the problem of growing crops**. Proceedings of 5th Pacific Science Congress, Canada.

A review paper of research in Java on growth rings and their significance in the tropics; floral biology of teak, susceptibility of tree roots to oxygen, morphology of root systems, root competition, shoot growth of teak and germination of teak seed.

1184 Dupuy, B; Verhaegen, D. 1993. **Plantation-grown teak (*Tectona grandis*) in Cote d'Ivoire**. (French). Bois et Forests des Tropiques 235: 9-24.

A brief account is given of the research undertaken in the last twenty-five years, covering tree breeding, progeny trials, genetic improvement, provenance studies, nursery techniques, vegetative propagation, silvicultural treatments and wood properties of teak.

1185 FAO. 1960. **Report of the working party on silviculture and management**. FAO Teak Sub-Commission FAO/TSC-60/3.1: 6p.

As per the approved programme of work, specific detailed projects of priority are listed in participating countries and ad hoc projects of high priority mainly in Burma, Ceylon, India, Pakistan and Thailand are listed.

1186 FAO. 1967. **Teak as an exotic plantation species**. Asia-Pacific and African Forestry Commission, Teak Sub-Commission, Rome FAO T-67/5: 3p.

In India, plantations of teak occur outside natural range in states of Uttar Pradesh, West Bengal, Bihar, Assam and Union Territory of Andamans. Figures of growth and yield are given and practice of establishment, tending and thinning are described. On good sites teak is grown for timber on the rotation of 60-80 years while on poor soils its is grown on short rotation of 30-45 years for poles or small timber production.

1187 Farrer, R.P. 1960. **The first eight years on the ronds**. Empire Forest Review 39(1): 89-93.

Rondo-a small plateau of 2000-3000 ft. altitude in Southern Tanganeyike with *Cholorophora excelsa* as natural species in forest is described. The paper gives an account of introduction of teak and most dominant of successful introduction is 34 ft. at 7 years age.

1188 Forest Department, Fiji. 1943. **Notes on growing teak**. Annual Report, Forest Department, Fiji: 5p.

Brief notes are given on the growth characteristics and possible uses of *Tectona grandis* and other species, which have been planted on an experimental scale in Fiji.

1189 Forest Department, Nigeria. 1941. **On teak growing in Nigeria**. Annual Report, Forest Administration, Nigeria 1940: 14p. Forest Department, Nigeria.

Teak has been raised successfully from direct sowings.

1190 Forest Department, Trinidad and Tobago . 1939. **Progress report on teak planting in Trinidad and Tobago**. Annual Administration Report, Forest Department, Trinidad and Tobago, 1938.

Teak planting has proved successful in the past and it is planned to expand the project. Thinned teak stand can be successfully underplanted with Balata (*Mimusops balata* var. *cruegeri* Pierre). The burning of slash on nursery beds of a stiff clay soil prior to sowing with Cypre and Cedar resulted in better survival and health of the seedlings. Manurial treatment with Nicifos has a beneficial effect on chlorotic teak trees.

1191 Forest Department, Trinidad and Tobago. 1942. **Progress report on teak planting in Trinidad and Tobago**. Annual Administration Report, Forest Department, Trinidad and Tobago 1940/41. Forest Department, Trinidad and Tobago.

The heartwood of Trinidad grown teak was found to be distasteful to drywood termites.

1192 Forest Research Institute, Dehra Dun. 1960. **Proceedings of the Ninth Silvicultural Conference, Dehra Dun, 7, 10-19 December 1956. Part I**. Forest Research Institute, Dehra Dun: p409.

Contains seventy three papers including natural and artificial regeneration of teak.

1193 Forest Research Institute, Dehra Dun. 1966. **Proceedings of the Tenth Silvicultural Conference, Dehra Dun, 15-20 November and 22-25 November 1961. Volumes I and II**. Forest Research Institute and Colleges, Dehra Dun.

Papers on natural and artificial regeneration of sal, teak and other species are also included.

1194 Gilbert, G. 1927. **La sylviculture aux index-Netherlandaises**. Bulletin of Agriculture Congo Belge 20(4): 479-500.

Teak is regenerated by clear-felling existing crop and planting with stumps in combination with taungya culture or agri-silviculture. Other methods, include coppice with standards system, which affords soil protection and stand improvement; but this is inferior to growing mixed plantation with *Leucaena glauca*.

1195 Hardjodarsono, M.S. 1977. **Teak**. (Indonesian). 86p. Universitas Gajah Mada, Yogyakarta, Indonesia.

1196 Imam, S.A. 1969. **Silviculture and silvics of teak**. Forest Dale News 1(4): 49-61.

A brief review.

1197 Jhilmit, S. 1992. **Manual for the production of teak in Trinidad**. Forestry Division, Mimeo: 67p.

1198 Keita, J.D. 1964. **Teak at Bamako**. (Hebrew; French). La-Yaaran 14(4): 117-122; 132-137.

In a dry forest type with Isoberlinia doka stump plants of teak were planted. The area was weeded twice in the first dry season, dust-mulched at the end of the rains and cultivated groundnuts in the second year. The early growth data indicate that it should be possible to produce stems with approximately 10 m. of good bole.

1199 Keogh, R.M; Pentsil, M.Y. 2001. **Teak in Ghana, a best practice of field guide**. Forest Plantation Development Centre, Ghana.

1200 Kermode, C.W.D. 1957. **Teak-the silviculture of gregarious types**. FAO Forestry and Forest Products Studies 13 (Tropical Silviculture Vol.II): 168-178.

The occurrence of teak in various forests of Burma is described along with site factors. Observations are made on the silvics of teak (seedling habits, germination and growth habits), and management systems and silvicultural operations designed to induce or establish regeneration of teak, and the effect of bamboo flowering on natural regeneration are also discussed.

1201 Kinloch, D. 1945. **Silvicultural notes on some of the more important Gold Coast trees**. Government Printing Department, Accra: 70p.

The notes indicate certain silvicultural properties of twenty nine important indigenous species and a few exotics including *Tectona grandis*.

1202 Kushalappa, K.A. 1977. **Teak plantations in Thailand**. Indian Forester 103(5): 323-328.

A general account of management, seed collection, nursery practice, site preparation and labour is given. Regeneration is mainly artificial by planting stump plants, which are prepared in permanent nurseries. The creation of forest villages near the teak plantations has helped to ensure a more regular supply of labour.

1203 Kyi, Maung. 1962. **Silvicultural papers relating to teak in Africa**. UNCSAT Conference, United Nations, Geneva E/CONF 39 C/13, 45, 110, 206, 380: p6; 4; 8; 4; 5.

Includes the use of teak for forestry development in lower and middle Casamenca (Senagal).

1204 Lowe, R.G. 1973. **Silvicultural characteristics of trees in growth plots by pattern analysis and stand curve analysis on the electronic computer**. Federal Department of Forest Research, Nigeria, Forest Series, Research Paper 13: 14p.

Describes a method for assessing the silvicultural characteristics of growth plots and presents results obtained by its application to unthinned 0.4-acre plots, at several sites in the main forest zones of southern Nigeria. Comparison between different species on the same site, and the same species on different sites, is made by combining the results of pattern analysis and stand-curve analysis.

1205 Martinez, H.A; Robles, X. 1986. **Silviculture of various species of multipurpose trees**. (Spanish). Chasqui 12: 4-16.

Data are presented and discussed on the silvicultural characters, principal uses, site requirements, silviculture and growth of six species including *Tectona grandis* selected for growing in Central America by the CATIE/ROCAP fuelwood projects. A bibliography containing references for each species compiled by X. Robles is appended.

1206 Quint, M.P.L. 1957. **Report on teak in Dahomey - the silviculture of gregarious types**. Tropical Silviculture 2, (FAO Forestry and Forest Products Studies 13): 233-236.

Deals with teak in Dohomey under the heads manmade forest, geographic distribution, ecology, sowing, growth, silviculture and forest protection.

1207 Rao, V.S.J. 1959. **Teak in Andhra Pradesh**. Proceedings of All India Teak Study Tour and Symposium, December 1957-January 1958: 166-168. Forest Research Institute, Dehra Dun.

Notes on the occurrence of teak forests in Andhra Pradesh are included. Teak is regarded as a constituent species of the dry deciduous forests of Godavari and Krishna river valleys. 5 to 35 percentage of teak is reported in mixed forests. The status of natural regeneration in different forest managed under selection-cum-improvement, simple coppice and coppice with reserve system was discussed. The paper also contains a note on artificial regeneration of teak and local experiments on thinning.

1208 Rappard, F.W. 1961. **Teak in Netherlands, New Guinea**. Ned. New-Guinea 9(6): 10-11; p13; p15. Agricultural University, Wageningen.

It is suggested that one of the ways to prevent a shortage of building timbers in the future is to establish teak plantations near Meranke, South New Guinea where the monsoon climate favours the growth and health of such plantations.

1209 Roosendael, J van. 1935. **Setting out of teak**. Tectona 28: p954.

1210 Sagreiya, K.P. 1959. **Silviculture and management of the teak forests of Madhya Pradesh**. Proceedings of All India Teak Study Tour and Symposium, December 1957-January 1958, Dehra Dun: 69-72.

Management of dry and moist teak forests of Madhya Pradesh and its regeneration are discussed.

1211 Shukla, S.K. **Our trees - teak**. Intensive Agriculture 17(9): p28.

1212 Simmons, C.E. 1930. **Progress report of the forest research work in India for 1928-29, Chapter V**. Forest Research Institute, Progress Report: 156-158.

1213 Srijono, D.W. 1979. **Saving the simplisia in the teak forest**. (English; Indonesian). Duta Rimba 5(32): 3-6.

1214 Sukwong, S. 1979. **Six years of silvicultural system trials in demonstration teak forest of Lampang**. (Thai). Proceedings of the Forestry Conference, 20 November 1979, Bangkok: 111-119. Ministry of Agriculture and Cooperatives, Bangkok.

1215 Trevor, C.G. 1928. **Progress report of forest research work in India, 1926-27, Chapter V**. Government of India Press, Calcutta: p224.

Gives notes on the insect *Hapalia machaeralis*.

1216 Trivedi Babu, N.V. 1997. **Silviculture of teak with special reference to Kerala**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 7-14. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

In India, its natural zone of distribution is mostly confined to Peninsular region below 24 degree latitude. Teak thrives best in fairly moist-warm tropical climate. In Kerala, it extends up to an elevation of 1200 m in the Western Ghats, best growth is obtained at or below 600 m. Generally, teak prefers basic soils. It is a very strong light demander and appears to be extremely sensitive to drought, particularly in the first year. Stumps serve as the main source of propagule for artificial regeneration. Nursery, planting, and thinning techniques followed in the State and problems in pure as well as mixed teak plantation are discussed. Identifying suitable short rotation species for mixed planting, improving the vegetative propagation methods, investigating the limiting factors for the natural regeneration, etc. are aspects suggested for future research.

1217 Troup, R.S. 1921. **The silviculture of Indian trees**. Clarendon Press, Oxford: 697-798.

A complete record of knowledge and experience grained in India and Burma. The subjects covered are occurrence, distribution, ecology, botanical and silvicultural characters, silvicultural systems, protection and growth statistics.

1218 Ugalde Arias, L.A. 1997. **Results of 10 years of silvicultural research in the Madelena project in Honduras**. Serie Tecnica: Informe Tecnico Centro Agronomico Tropical de Investigacion y Ensenanza 288: 179p. Turrialba, Costa Rica.

An account of silviculture research on eight species in Honduras including *Tectona grandis* is given. The accounts cover botany, ecology, site requirements, characteristics and uses, silviculture, details of experimental field work and the results of growth studies.

1219 Ugalde Arias, L.A. 1997. **Results of 10 years of silvicultural research in the Madelena project in Costa Rica**. Serie Tecnica: Informe Tecnico Centro Agronomico Tropical de Investigacion y Ensenanza 290: 162p. Turrialba, Costa Rica.

An account of research on seven species including *Tectona grandis* in Costa Rica is given. The accounts cover botany, ecology, site requirements, characteristics and uses, silviculture, details of experimental field work and the results of growth studies.

1220 Ugalde Arias, L.A. 1997. **Results of 10 years of silvicultural research in the Madelena project in Nicaragua**. Serie Tecnica: Informe Tecnico Centro Agronomico Tropical de Investigacion y Ensenanza 292: 175p. Turrialba, Costa Rica.

An account is given of research on twenty two species including *Tectona grandis* in Panama. The accounts for these species cover botany, ecology, site requirements, characteristics and uses, silviculture, details of experimental field work and the results of growth studies.

1221 Ugalde Arias, L.A. 1997. **Results of 10 years of silvicultural research in the Madelena project in El Salvador**. Serie Tecnica: Informe Tecnico Centro Agronomico Tropical de Investigacion y Ensenanza 291: 189p. Turrialba, Costa Rica.

An account is given of research on eleven species including *Tectona grandis* in El Salvador. The accounts cover botany, ecology, site requirements, characteristics and uses, silviculture, details of experimental field work and the results of growth studies.

1222 Ugalde Arias, L.A. 1997. **Results of 10 years of silvicultural research in the Madelena project in Panama**. Serie Tecnica: Informe Tecnico Centro Agronomico Tropical de Investigacion y Ensenanza 293: 113p. Turrialba, Costa Rica.

An account is given of research on nine species including *Tectona grandis* in Panama. The accounts cover botany, ecology, site requirements, characteristics and uses, silviculture, details of experimental field work and the results of growth studies.

1223 Vallejo, A.P. 1977. ***Tectona grandis***. (Spanish). Forestal 1(6): 20-22.

A brief note on the silvicultural characteristics of *T. grandis* and on the behaviour of this species when introduced into various countries, including Puerto Rico, Venezuela and Trinidad.

1224 Vidal, M.P.H; Williams, G.H.D. 1956. **Teak as a plantation tree in Sudan**. Forestry Memoirs 8. Agricultural Publication Committee, Khartoum.

The oldest teak plantation is traced back to 1920. The provenance introduced is best without fluting. Teak is considered resistant to fire and suppresses grass hazard of fire. Faster growth, easy to raise in nursery, seed collection easy, stump planting and transport advantage, fairly hardy and drought tolerant, termite proof, best pole of hardwood and a ready sale of thinned produce are the advantages of growing teak plantation.

1225 Wycherley, P.R. 1966. **Teak problems in north Thailand**. Malaysian Forester 29(2): 64-68.

Silvicultural problems in natural regeneration of teak forests and reestablishment of teak after taungya cultivation in N. Thailand are discussed. The work of the Danish-Thai Teak Improvement Centre on the selection and propagation of superior trees is described.

1226 Zon, P van. 1955. ***Tectona* from beginning to the end**. Tectona 43: 236-239.

1227 Zuhaidi, A.Y; Zakaria, I; Rosdi, K; Krishnapillay, B. 2002. **Species for timber plantations**. A manual for forest plantation establishment in Malaysia: 13-24. Forest Research Institute Malaysia, Kuala Lumpur, Malaysia.

This paper describes the growth, distribution and ecology and associated pests and diseases of twelve species including teak suitable for forest plantations in Malaysia.

Go top

Regeneration and Formation of Stands

1228 **Effect of forest fires on reproduction in teak forests**. Indian Forester 8, 1882: 158-159.

The author attributes hollowness of Burma teak to jungle fires and suggests fires help to accelerate germination by attacking the close tough felty covering round the seed and the failure of twice-repeated sowings in Tharrawaddy and Porone districts might be avoided by mixing seed with dry grass and giving a light burn before rains.

1229 **Natural regeneration of teak under uniform methods**. Indian Forester 44(2), 1918: 87-88.

Reported the natural regeneration of teak obtained in the clear felled area of Aravillicava plantation, 1844.

1230 **Teak regeneration**. Indian Forester 48(7), 1922: 399-401.

The method of teak regeneration in Bombay Presidency is described by clear-felling and sowing. Treated or untreated teak seeds are dibbled in each patch marked by a stake. Seedlings thrice weeded during rains and mulched. The causes for failures of this method are infertile seed and poor soil aeration and recommends ploughing and sowing in furrows of 18" wide strips. On steep slopes transplanting small seedlings or root and shoot pruned larger seedlings are preferred.

1231 **Teak regeneration**. Indian Forester 54(4), 1928: 267-269.

The various methods of teak regeneration are listed and the author is of the opinion that variation in natural regeneration attributed from year to year is more due to climatic factors, than to fires or fertility of seed or opening of canopy.

1232 **Regeneration of teak from coppice and seedlings in U.P., India**. Forest Research in India, 1932: p88.

1233 **Forest research in India and Burma, 1939-40. Part I - The Forest Research Institute, Dehra Dun**. Manager of Publications, Delhi, 1941: 133p.

The effect of slash burning on artificial reproduction was found to vary with different species. It had a stimulating effect on stump plants of *Morus alba* and *Tectona grandis*. Analysis of soil samples indicated that burning and the application of ash have a marked effect in increasing the pH, while soils on which the slash was burned and the ash removed showed a relatively low value for nitrates.

1234 **On teak regeneration and slash burning**. Silviculturist's Report for Central Provinces and Berar for the year 1941: 9-10.

In a planting experiment with teak, the original high mixed forest was clear felled and the slash burnt preliminary to planting. In an area where the slash burn was intense the teak plants showed greater vigour than in an area where the burn was very light.

1235 **Annual report on silvicultural research in the Madras Presidency for the year 1939-40**. Superintendent, Government Press, Madras, 1941: 165p.

Stump planting is reported as the best method of artificial regeneration for *Tectona grandis*.

1236 **On factors effecting teak regeneration**. Aministrative Report, Forest Department, Central Provinces and Berar 31 March 1940: 38p. Government Printing Press, Nagpur, 1941.

Bamboo regrowth is considered as a serious obstacle to teak coppice in the moist type. This can be overcome by felling and burning the bamboo a year or so before the main fellings, cutting and regrowth with the tree crop, burning the felling debris and removing all bamboos interfering with teak coppice. In forests, where Lantana is an obstacle for teak regeneration, the burning of the shrub for three years in succession prior to main fellings appears to improve conditions.

1237 **Effect of gregarious flowering of bamboo on forest regeneration**. Forest Reserch Central Provinces and Berar 1947-48, 1948: 18p.

After gregarious flowering and death of bamboo *Dendrocalamus strictus* - profuse regeneration of teak and other tree species was observed. But it is observed that dense bamboo regeneration is likely to suppress the tree species.

1238 **Reforestation of poor land in the teak region**. (Dutch; Javanese). Rapp, Bosbouwproefsta. Buitenzorg 10, 1949: 12p .

By the application of phosphates soils can be improved, but results are not reliable; acid grasslands can be improved by cultivation for 1 to 2 years under agricultural crops. Tree species are recommended for the worst soils. The growth characteristics, volume production, diseases and pests, and economic uses of each species are discussed.

1239 **Natural regeneration of teak**. Forest Research in India Part II, 1950-51: p48. Forest Research in India and Burma, 1951.

The natural regeneration of teak is considered as a problem in moist high forests of Warla and Kathiawada ranges of Madhya Bharat. Where *Sorghum hopensis* and other miscellaneous species are a hindrance to natural regeneration and establishment of teak seedlings.

1240 **Artificial regeneration**. Forest Research India and Burma Part 1, 1955: 22-35.

Reports on a number of experiments on winter planting and use of split stumps of different species including *Tectona grandis*.

1241 **Artificial regeneration: Effect of planting split stumps as compared to normal stumps on survival and subsequent growth**. Forest Research in India and Burma 1950-51, Part I, 1955: 27-28.

Splitting into four stumps seems to be better than no splitting or splitting into two, and splitting into two is better than no splitting at all.

1242 **Natural regeneration by seed**. Forest Research in India Part II 1954-55, 1955: p72.

Preliminary observations in Madras state, indicate that a light ground fire in teak plantation induces and accelerates natural regeneration.

1243 **Regeneration experiments in Papua**. Australian Timber Journal 25(9), 1959: 41-56.

Describes a management programme begun by the Forest Service in 1954 for introducing different species including *Tectona grandis* into 1800 acres of the virgin rain forest of the Brown River Area of Papua. The best progress was made by *T. grandis*, *E. torrelliana* and *E. deglupta*, which are held to be the most suitable for replanting the cut-out rain forest on the better soil types.

1244 Ahmad, Y.S. 1951. **Will teak regenerate naturally in the Chittagong Hill Tracts**. Pakistan Journal of Forestry 1(3): 271-272.

Teak forests of 78 years old are ready for exploitation. An experimental area has been laid out, in which 1/4 of the trees will be removed every 3rd year. After each felling, all second-storey species of bamboos and shrubs, will be cut and burned by hoping that this treatment will help teak to regenerate naturally.

1245 Aiyar, M.R.S. 1917. **Concentrated regeneration of teak**. Indian Forester 43(4): 199-201.

Describes the experiments conducted in Takkadi leased forests of the Anamalai. In one plot bamboo was cut but area not burnt and the natural teak forest seed was dibbled without any treatment, in an area where trees are left standing and area is weeded four times. In second plot everything was cut, bamboo up-rooted, cut-material removed and without any burning teak seed dibbled and weeded. Best results got from the second plot.

1246 Allsop, F. 1947. **Natural regeneration of teak in Mong Mit forest division, Shan States, Burma**. Indian Forester 73(9): 399-400.

In some parts of this forest division there is much natural regeneration of teak, locally as dense as an ordinary plantation. The prescribed cleaning and thinning operations are described.

1247 Altona, T. 1928. **Teak regeneration in British India**. (Indonesian; English). Tectona 21: 629-645.

The regeneration practice is described in chronological order. The draw-backs in natural regeneration of teak are uneven seedling crop, slow growth, heavy weeding and tending costs. Planting under taungya is considered as the best method.

1248 Aung, D.U. 1949. **Natural regeneration of teak after gregarious flowering of *Bambusa polymorpha***. United Nations Scientific Conference on the Conservation and Utilisation

of Resources, Lake Success, 1949. U.N.S.C.C.U.R, Lake Success, USA.

After bamboo flowering teak seedlings, even though suppressed by weeds, may survive and establish when the top-canopy is lightened, and the young crop is assisted by weeding and improvement fellings.

1249 Aung, D.U. 1951. **Selection of silvicultural techniques**. Proceedings of United Nations Scientific Conference on the Conservation and Utilization of Resources, Lake Success, 1949, 5: 117-120.

Discusses methods of ensuring regeneration in teak forests and the plain reserves and the programme of research in Burma.

1250 Aung, U.M. 1979. **Some aspects of artificial regeneration in Burma with particular reference to teak (*Tectona grandis* Linn.f.) and *Eucalyptus* spp**. Tropical Agriculture Research Series 12: 89-95.

1251 Banoewidjojo, M. 1957. **Note on natural regeneration of teak: Indonesia**. FAO Teak Sub-Commission FAO/TSC-57/28: 4p.

The history of natural regeneration of teak in Indonesia from 1854 (after Millier), 1896 (Kunst) and 1905 (Tobi) is described. The method of natural regeneration followed is described and the problem is indicated.

1252 Barrett, H.B. 1939. **Note on Mohnyin Reserve, Mitkyina Division**. Indian Forester 65: 550-558.

Mohnyin Reserve is rich in teak, but natural regeneration is poor. Briefly given the history of Mohnyin reserve, its constitution, exploitation and revenue of the reserve.

1253 Barrett, H.B. 1947. **The natural and artificial regeneration of teak in Burma**. Irish Forestry: 4-10.

1254 Becking, J.H. 1928. **The culture of teak on Java - a comparison of different methods of teak regeneration in Java**. Dissertation, Wageningen, The Netherlands.

1255 Becking, J.H. 1929. **Methods of teak regeneration in Java**. (Indonesian). Forestry Rundschau 2: 82p.

1256 Beekman, H. 1919. **The forest regeneration question**. (Indonesian). Tectona 5: p1.

1257 Blanford, H.R. 1917. **Teak regeneration under the uniform system in Mohnyin, Burma**. Indian Forester 43(8): 339-362.

Advantage of combining regeneration with taungya cutting is pointed out. The experimental taungya method is described and suggests to complete extraction of timber before regeneration. The author advocates artificial regeneration to replace natural regeneration methods. The problem of introduction of mixtures is discussed.

1258 Blanford, H.R. 1925. **Regeneration with assistance of taungya in Burma**. Indian Forest Records (Silviculture Series) 2(3).

1259 Blanford, H.R. 1946. **Natural and artificial regeneration of teak in Burma**. Empire Forestry Review 25(1) [Indian Forester 73, 1947: 127-129].

A review paper gives the following conclusions on natural regeneration - (1) In moist tropical forest it is inferior in results to taungya (2) established regeneration already existing can be tended at reasonable cost like girdling, and improvement fellings in bamboo flowered areas, (3) In drier teak forests natural regeneration can be established by the use of taungya. Gap planting in bamboo flowered areas and the methods and possibility to supplement natural regeneration are also discussed.

1260 Boonkird, S; Unahanand, P. 1959. **Report of the result of experiment on teak regeneration**. (Siamese). Vanasarn 17(1): 9-14.

Results of the statistical experiments in replicated plots laid out in natural teak forest are presented. Experiments are as follows: (1) undergrowth removed, (2) undergrowth burnt, (3) undergrowth removed and soil broken to 20 cm. depth, (4) combination of cutting and burning undergrowth with soil cultivation, (5) control. Assessment of results after a year showed no significant difference in number or size of teak regeneration as between treatments or the control.

1261 Brooks, R.L. 1938. **Notes on the growing of teak (*Tectona grandis* Linn.f.) in Trinidad**. Trinidad Forest Department Leaflet 7: 14p.

Contains an account of teak in its natural habitat in Trinidad, with notes on silvicultural characters and requirements, formation and tending of stands and utilization. Statistics are given for the Trinidad plantations. Yield tables are given for comparison with those of the Indian plantations at Nilambur.

1262 Bruce, C. 1906. **The reproduction of teak**. Indian Forester 32(8): p390.

Illustrating the continuous and yearly felling of bamboos under Burma improvement fellings, describes the beneficial way teak has sprung up over the last 15 years. The effect is more pronounced in outside fire-protected areas. Fire protection is harmful to teak due to profuse growth of bamboo.

1263 Bruinsma, A.E.J. 1927. **Notes on the regeneration of teak forests-1903**. (Indonesian; English). Tectona 20: 283-308.

1264 Buit, S.S. 1959. **A note on the occurrence and regeneration problems of teak, in Vidharbha**. Proceedings of All India Teak Study Tour and Symposium, 1957 December - 1958 January, Forest Research Institute, Dehra Dun, 1959: 154-156.

Describes teak forests of Vidharbha. Plantations using stumps or transplants using local Dona technique are successful, but artificial regeneration over large areas is considered costly. The difficulty in obtaining natural regeneration locally is discussed. It was concluded that the micro-edaphic factors, soil moisture, intensity of light etc. explain the variation in regeneration conditions.

1265 Carrapiett, J.B. 1955. **Regeneration of teak in Burma**. Burmese Forester 5(1): 48-57.

Describes the methods of regeneration used in the old plantations in gaps in the forests, regular plantations made since 1918 and natural regeneration obtained by girdling and climber cutting.

1266 Cater, J.C. 1941. **The formation of teak plantations in Trinidad with the assistance of peasant contractors**. Caribbean Forester 2: 147-153.

The cleared forest land selected for planting teak is allotted to peasant contractors for 15 months in return for keeping the area free from weeds and complying with other specified requirements. They plant and harvest one crop before and another crop after the planting of stump plants of teak by the Forestry Department.

1267 Champion, S.H; Brasnett, N.V. 1958. **Choice of tree species**. FAO Forestry Development Paper 13, 1958: 307p.

This section of the World Forest Planting Manual deals with the principles and factors that guide the choice of tree species for planting on various sites. Part 3 of the publication includes information about selected species including *Tectona grandis*.

1268 Chaubey, O.P; Tiwari, K.P. 2000. **Natural regeneration in managed forests**. Vaniki Sandesh 24(4): 14-27.

This paper discusses the different factors affecting regeneration of forest ecosystems in Madhya Pradesh such as restoration, rehabilitation, reclamation and assisted natural regeneration. The results of case studies on the regeneration of sal and teak are described.

1269 Chaudhuri, A.B; Sowani, M.Y; Mahajan, N.M; Agarwala, V.P; Datta, R.C; Ullah, M.H; Ticku, B.L; Singh, J; Qureshi, I.M; Saxena, V.S. 1977. **Recent trends in techniques of artificial regeneration**. Proceedings of the 11th Silvicultural Conference, Dehra Dun, 15-25 May 1967: 483-540. Forest Research Institute, Dehra Dun.

Dealt with different species which include teak and *Eucalyptus* in Mysore.

1270 Chitwadgi, S.S. 1954. **Artificial regeneration with selection methods of working compensatory diffuse plantations**. Indian Forester 80(3): 160-164.

Discusses with the teak forests of N. Kanara, Bombay, the advantages of supplementing advance growth by patch planting in gaps instead of clear felling and planting, and the resultant problems of management.

1271 Chitwadgi, S.S. 1956. **Teak regeneration in the forests of Bhopal state (Madhya Pradesh)**. Proceedings of the 9th Silvicultural Conference, Dehra Dun, 1956 Part I: p84.

It is suggested that the present system of coppice with reserves should be abolished and simple coppice supplemented with artificial planting be adopted. Planting should be in patches and the total area planted should be 10-25 percent of the annual coupe.

1272 Chollet, A. 1956. **Teak in Togoland**. (French). Bois et Forests des Tropiques 49: 9-18.

The introduction of teak dates from 1905; it now covers 4500 ha. and its power of vigorous natural regeneration has resulted in the formation of gallery forest from roadside plantings. Afforestation of savanna, by taungya or by direct planting after grass cutting, is now being undertaken on a large scale. Methods are described.

1273 Chuntanaparb, L. 1969. **Effects of improvement felling on increment and natural regeneration of teak forests**. (Thai; English). Forest Research Bulletin 7: 25p. Kasetsart University, Bangkok.

Data on teak increment in terms of girth, basal area merchantable volume as well as natural regeneration of teak were recorded annually in Mae Huad Forest, Amphur, Ngao Lampang. Increase in natural regeneration of teak was found to be effected by improvement felling.

1274 Conolly, J.D. 1928. **Teak regeneration**. Indian Forester 54(6): 377-378.

The author emphasizes the effect of soil aeration on second rotation teak crops in Nilambur, after describing the method of regeneration adopted, and considers that height growth almost doubles in first two years with soil aeration and ploughing.

1275 Dasappa. 1989. **Geographical distribution and problems of regeneration in teak (*Tectona grandis* Linn. f.)**. Myforest 25(4): 337-355.

A review with reference to the ecology and silviculture of teak in the tropics.

1276 Davis, L.C. 1904. **Reproduction of teak in bamboo forest in Lower Burma**. Indian Forester 30(8): 378-381.

Author is of the opinion that we can improve the condition of the forests by removing mature teak trees and the consequence will be serious if all teak seed bearers are removed. It will affect the natural regeneration of teak.

1277 Dawkins, C.G.E. 1921. **Early burning in young regeneration areas**. Burma Forest Bulletin 2: 1-6.

1278 Dhanmanonda, P; Sahunalu, P. 1992. **Research on natural forests**. Proceedings of the Seminar on 50 Anniversary of Hyay-Tak Teak plantation, Bangkok, 5-8 August 1992.

Past and present studies on the mixed deciduous forest with teak at Mae Huad, Lampang province are compiled. The establishment period of teak ranged from 4-30 years. Teak harvested in Northern Thailand in 1985 was only one-tenth of that harvested in 1971. The dramatic decrease has been attributed by some authors to loss of trees through shifting cultivation and intensification of modern agriculture. This report examined the possibility that previous removal of large trees during selective logging is also a reason for present low yield of teak. After selection cutting, most of the remaining teak was concentrated in diameter size classes less than 50 cm.

1279 Dhareshwar, S.S. 1939. **Honavar Range and teak regeneration**. Indian Forester 65: 406-424.

The forests of the Honavar Range in the Western Forest Division, Kanora, cover an area of approximately 184 square miles. A portion of the reserve forest has been organized under four different working plans, the most important of which is the Working Plan for the Below Ghat Inland Forests which is concerned with the management of nearly 38 square miles of the moist deciduous forest. This plan was introduced in 1928 and its object is to. convert the forest into a timber-producing, teak-bearing, deciduous mixture with at least 50 percent teak. The prescribed treatment is clear felling with artificial regeneration of teak.

1280 Dubey, R.K. 1967. **Natural and artificial regeneration in teak forest in Madhya Pradesh**. Proceedings of 11th Silvicultural Conference, Dehra Dun, 1967 Part I Item 2.

The paper makes a classification of teak zone of Madhya Pradesh into smaller types according to climate, and status of natural regeneration with prospects of teak reproduction in each type both by natural and artificial means.

1281 Egenti, L.C. 1979. **On seeding habits of *Tectona grandis* Linn.f.** Proceedings of a symposium on flowering and seed development in trees, Mississippi State University, 15-18 May 1978: p360. Southern Forest Experiment Station, Starkville, Mississippi.

The state of knowledge of the ecology of teak and the relationship of the species with the environmental factors.

1282 Essenburg, J.F.W. 1937. **Additional natural regeneration (teak) after 35 years in the first and fifth annual plots in Motatal in the Randoeblatoeng forest section**. Tectona 30: p716.

1283 FAO. 1993. **Teak: A plundered world heritage. A memorial issue**. RAPA Occasional Paper 8: 15p. FAO.

1284 Forest Department, Burma. 1949. **Natural regeneration of teak**. Report of Working Plans, Silviculture Entomology, Forest Department, Burma 1945-46: 39p.

The efforts to induce natural regeneration in Shan states was described and the problems of invasion by dense growth of *Eupatorium odoratum* on clearings made under seed bearers was discussed. Damage to established regeneration by elephants was also indicated.

1285 Forest Research in India and Burma. 1941. **On slash burning and teak regeneration**. Forest Research in India and Burma 1939/40, Part I: p133.

The effect of slash burning on artificial reproduction was found to vary with different species and has a stimulating effect on the stump plants of teak. Beneficial effects were generally slightly greater for areas where slash was burnt and the ashes worked into top soil of unburned plots. Analysis of soil samples taken from the treated plots indicated that burning and application of slash have a marked effect in increasing the pH, while soils on which the slash was burned and the ash removed showed relatively low value for nitrates.

1286 Forest Research in India and Burma. 1941. **On teak natural regeneration in Burma and Madras: Stump planting of teak**. Annual Report of Forest Administration, Silviculture Research in Burma and Madras 1938/39. Forest Research in India and Burma.

Frill girdling and sodium arsenitic poisoning of the larger trees round teak seed bearers as an aid to natural regeneration is found to be less costly than felling but the degree of success is yet uncertain in Burma. In Madras details of teak nursery techniques along with costs are given.

1287 Forest Research Institute, Dehra Dun. 1947. **The natural and artificial regeneration of teak**. Proceedings of the 6th Silviculture Conference, Dehra Dun, 1945: 71-84.

Nine papers describing current methods and opinions on Teak regeneration in different provinces.

1288 Forest Research Institute, Dehra Dun. 1956. **Natural regeneration of teak**. Proceedings of the 9th Silvicultural Conference, Dehra Dun, 1956.

The problem with reference to different mixed deciduous both dry and moist types was discussed and recommendations were made for augmenting natural regeneration of teak and undertaking a joint cooperative work of teak forest areas was recommended to determine the most feasible technique of natural regeneration of teak.

1289 Forest Research Institute, Dehra Dun. 1956. **Artificial regeneration of teak**. Proceedings of the 9th Silvicultural Conference, Dehra Dun, 1956: p90.

Reviewing extensive research undertaken during the last three decades on the artificial regeneration of teak.

1290 Forest Research Institute, Dehra Dun. 1961. **Recent trends in techniques of artificial regeneration**. Proceedings of the 10th Silvicultural Conference, Dehra Dun 1961, Vol. 1: 335-438.

Includes two papers on *Tectona grandis*.

1291 Forest Research Institute, Dehra Dun. 1961. **Recent trends in techniques of natural regeneration (teak)**. Proceedings of the 10th Silvicultural Conference, Dehra Dun, 1961, Vol. 1: 287-292.

It was recommended to implement the recommendations of All India Teak Symposium of 1957-58, particularly specific procedures for obtaining natural regeneration in very moist types and to undertake cooperative research projects for obtaining natural regeneration with teak as predominant constituent.

1292 Forest Research Institute, Dehra Dun. 1967. **Recent trends in techniques of natural regeneration of teak**. Proceedings of the 11th Silvicultural Conference, Dehra Dun: p605.

(a) Considerable areas of dry, semi-moist and moist teak forests in Madhya Pradesh, Maharashtra, Gujarat, etc., are managed under systems of natural regeneration (b) comprehensive study of the factors governing the recruitment and establishment of teak regeneration has not been done in detail; (c) the technique for inducing natural regeneration has not been perfected so far, particularly in areas infested with weeds.

1293 Forest Research Institute, Dehra Dun. 1967. **Recent trends in techniques of artificial regeneration of teak**. Proceedings of the 11th Silvicultural Conference, Dehra Dun: p607.

Extensive teak plantations are being raised in many states, seed collection, pre-treatment and grading planting stock need improvement, proper evaluation of the plantation sites in non-teak areas as to their suitability is of vital importance, the role of chemical fertilizers, weedicides and their economics has not been studied in detail.

1294 Forest Research Institute, Dehra Dun. 1977. **Recent trends in techniques of natural regeneration**. Proceedings of the 11th Silvicultural Conference, Dehra Dun, 15-25 May 1967: 408-482. Forest Research Institute, Dehra Dun.

Reports are given on problems and progress with various species and in various regions which include a report of teak in Madhya Pradesh.

1295 Foulkes, F. 1914. **Teak in the Wynaad: A study Part III M. (C). Reproduction of teak from seed**. Indian Forester 40(7): 315-330.

Information is furnished from Wyanad and advocates detailed study of teak in its natural habitat in different sites.

1296 Gamble, J.S. 1921. **Artificial regeneration of teak by sowing**. Indian Forester 47(1): 43-44.

The author describes the pretreatment method of teak seeds as practiced in Bomanpokri T.P. Darjeeling Division in 1874, which consisted of mixing the seed with soil and watering in an exposed sunny area and germinating seeds transferred to beds.

1297 Gogate, M.G; Ghude, D.B; Deshpande, M.D. 1997. **Experimental entire transplant technique for teak**. Indian Forester 123(9): 793-800.

Teak is normally artificially regenerated using the stump planting technique. The loss of almost one year's shoot growth necessitated by this method could be avoided by using the Entire Transplant Technique (ETP). This paper reports pilot scale work on the use of ETP for teak at the Wada Research Nursery.

1298 Griffith, A.L. 1942. **The effects of burning on the soil as a preliminary to artificial regeneration**. Indian Forest Bulletin 13.

1299 Griffith, A.L. 1945. **The natural and artificial regeneration of teak**. Proceedings of 6th Silvicultural Conference, Dehra Dun: 2-4. Forest Research Institute India, Dehra Dun.

The effect of war on silviculture and artificial regeneration of teak was discussed. Varying degrees of success has been achieved with natural and artificial regeneration. The author has reported the over exploitation of teak and recommends measures to normal management.

1300 Gupta, A.C. 1945. **The natural and artificial regeneration of teak**. Proceedings of 6th Silvicultural Conference, Dehra Dun.

Reports the problems of teak natural and artificial regeneration from Bengal from experimental plots in Kurseong Division. A comparative study of both methods of regeneration is made.

1301 Hamilton, A.P.E. 1954. **Methods of increasing growth and obtaining natural regeneration**. 4th World Forestry Congress, Session 5: Tropical Forestry FAO/54/9/4999: 1-34.

Teak types are described both natural and plantation origin in Africa and West Indies. Discussion is mainly confined to India and Burma. Teak distribution, silviculture and management practices are outlined and problems are suggested for future research.

1302 Hart, H.M.J; Noltee, A.C. 1927. **Regeneration and tending of teak**. (Dutch; English). Tectona 20: 199-213.

Oldest teak plantations date to beginning of 19th century. In 1865 natural regeneration is officially prescribed, and in 1873 agriculture silvicultural methods introduced. Interculture with *Leucaena, Indogofera galegoides* and *Imperata cylindrica* started around 1900. Inmixing will be carried more intensively and schedule of future thinning are suggested for teak plantations and choice of thinning methods discussed in detail.

1303 Hla, U.T. 1979. **Some observations of natural regeneration of teak (*Tectona grandis* Linn.f.) in teak bearing forests of Burma**. Tropical Agriculture Research Series 12: 97-105.

1304 Hodge, W.E. 1945. **The natural and artificial regeneration of teak**. Proceedings of 6th Silvicultural Conference, Dehra Dun 6.

Reporting from North Bengal and Chittagong Hills where teak has been sown for many years, the author opines poor quality teak fetches better price than first quality sale and reports on experiments in progress to find out suitable associates.

1305 Hussain, T. 1960. **Progress report on teak forestry in Pakistan 1957/1959**. FAO Teak Sub-Commission, New Delhi, 1960 FAO/TSC-60/2.8: 6p.

Mainly two aspects are covered ie., silviculture and management and utilization.

1306 Kadambi, K. 1956. **Natural regeneration of teak**. Proceedings of the 4th World Forestry Congress, Dehra Dun, 1954, 3: 293-298.

The author discusses the various factors which influence the natural regeneration of teak and its establishment and points out instances of natural reproduction of teak in India.

1307 Kadambi, K. 1957. **Natural reproduction of teak. The silviculture of gregarious types**. Tropical Silviculture 2: 187-192.

The factors influencing natural regeneration of teak are listed and the inherent capacity of teak seed is at first very sensitive to drought. Success of natural reproduction depends on water retentivity of soil during the summer months. The hard seed coat prevents premature germination and soft soil is required when seedling develops a strong tap root. The requirements of teak natural regeneration and establishment with reference to soil, light and other factors like weeds and grazing and fire are described and discussed.

1308 Kadambi, K. 1959. **Observations on natural reproduction of teak**. Indian Forester 85(11): 641-649.

A review of all the factors bearing on the problem in India.

1309 Kaikini, N.S. 1956. **Natural regeneration of teak**. Proceedings of the 9th Silvicultural Conference, Dehra Dun, 1956. Part 1: 58-65.

Described in some detail, by forest types.

1310 Kaikini, N.S. 1960. **Natural regeneration of teak in Bombay state**. Proceedings of the 9th Silvicultural Conference, Dehra Dun, 1956 Part I, 1960: 58-65.

Describes in some detail by forest types the natural regeneration of teak.

1311 Kartna, S. 1963. **Natural regeneration of teak**. FAO, Rome.

Observations are made on teak flowering and fruiting in Lampang, Thailand, and germination of teak seed and early growth of teak seedlings.

1312 Kermode, C.W.D. 1939. **The efficiency of irregular stocking Part II, Item 8**. Proceedings of the 5th Silvicultural Conference, Dehra Dun. Forest Research Institute, Dehra Dun.

In view of vastness of teak forest areas, conversion into even-aged areas is impracticable. The author recommends dealing such areas by girdling, mature trees followed by improvement fellings, to assist existing natural regeneration and tending groups of advance growth.

1313 Kermode, C.W.D. 1944. **Natural regeneration without seed bearers**. Indian Forester 70: 289-296.

The author discusses a technique for natural regeneration which has been employed in Burma. A great deal of unnoticed natural generation of teak and other species is present in these burned-over areas and will develop when the canopy is opened up.

1314 Kermode, C.W.D. 1945. **The natural and artificial regeneration of teak**. Proceedings of 6th Silvicultural Conference, Dehra Dun. Forest Research Institute, Dehra Dun.

It is reported that the natural regeneration in moist tropical forests is costly and less successful than taungya culture, at reasonable cost this can be established easily by assisting operations like girdling and improvement fellings and in dry teak forests regeneration of teak by taungya is cheaper and convenient than natural regeneration methods. The paper describes various methods of artificial raising teak in Burma.

1315 Kermode, C.W.D. 1946. **Natural and artificial regeneration of teak in Burma**. Indian Forester 72(1): 15-21.

In the drier teak-bearing forests, natural regeneration of teak can be established by the use of taungya. All teak plantations in Burma have for many years been made by taungya. A considerable amount of experimental work has been done on stump-planting. Other methods of introducing teak artificially have been tried like gap planting.

1316 Kermode, C.W.D. 1952. **The flowering of Kyathaungwa (*Bambusa polymorpha*)**. Burmese Forester 2(1): 9-14.

Notes on regeneration of teak after gregarious flowering of *B. polymorpha*.

1317 Kermode, C.W.D. 1954. **Have methods used for regenerating teak in Burma been failures?** Burmese Forester 4(2): 76-86.

Criticizing an article on teak regeneration by U Saw Tun Aung and maintains that artificial regeneration by taungya plantations and natural regeneration by the seedling coppice method are both good in suitable sites.

1318 Kermode, C.W.D. 1954. **Methods of increasing growth and obtaining natural regeneration of natural teak stands in Burma**. 4th World Forestry Congress, Dehra Dun Part I: 47-55.

The distribution of teak with floristics in six forest types is described. The ecological importance of fire has been discussed as well as a silvicultural toll in regeneration operations. The dormancy of teak seed for one or two years is examined critically and it is reported that research is needed to gain further information on germination and seed dormancy of teak seed and nature of natural regeneration and advance growth.

1319 Kermode, C.W.D. 1954. **Seedling coppice and the seedling coppice system of regeneration**. Empire Forestry Review 33(4): 366-374.

Many species of the mixed deciduous forest of Burma can survive the forest fire. Enumerations show that there is normally an advance growth of seedling coppice of much higher density especially teak. This advance growth can be helped by cutting and burning the overstorey and subsequent tending. Taungya cultivation is also found helping in the advance growth.

1320 Kermode, C.W.D. 1955. **Regeneration with the aid of taungya**. Burmese Forester 5(1): 86-99.

Describes the method of raising teak plantations by taungya method. The work in the first, second, third and subsequent years has been separately described.

1321 Kesarcodi, S.N. 1945. **The natural and artificial regeneration of teak**. Proceedings of 6th silvicultural Conference, Dehra Dun, Item 5. Forest Research Institute, Dehra-Dun.

The results of rab method of artificial regeneration of Bombay pole forests is discussed and compared this with natural regeneration methods both from coppice and seed. Artificial regeneration is found successful in the high forest areas.

1322 Kittinanda, S.P. 1963. **Natural regeneration of teak at Lampang**. (Siamese). Vanasarn 21(4): 261-268.

Only dominant and codominant trees produce seed in natural teak forest. The total seed production of the area was investigated in 1962. Despite heavy seed production, only a few seeds is found germinating. Growth of these seedlings also investigated.

1323 Kramer, F. 1930. **The teak regeneration in the Goendith forest district**. (Dutch; English). Tectona 23(4): 228-293.

Two methods were tried: dibbling seed in poor soils where teak is partially girdled and dibbling coupled with coppice regeneration on medium soils. First method yielded poor results and second method is far from satisfactory. Further research has to be based on natural succession and undergrowth studies of teak forest and offer plenty of sunlight to young teak plants and germinating seeds by planting in rows and soil tending and improvement.

1324 Krishnaswamy, V.S. 1951. **Notes on teak regeneration methods**. Proceedings of 8th Silvicultural Conference, Dehra Dun, 1951, Part 2: 238-239.

The present position in the regeneration technique of teak in the different states has been described. Both natural and artificial regeneration methods including Dona planting of Madhya Pradesh are described.

1325 Kulkarni, D.H. 1963. **Role of advance growth in silvicultural systems, with special reference to semi-moist deciduous forests containing teak (*Tectona grandis*) in Central India and the peninsular sal (*Shorea robusta*)**. Indian Forester 89(10): 663-669.

A general account stressing the need to encourage and preserve advance growth wherever it occur.

1326 Kutintara, U. 1970. **Regeneration of teak in Thailand**. Thesis, Colorado State University, Colorado, 1970: 127p.

The paper describes the methods of increasing teak regeneration and thus producing a higher stock of teak in teak bearing forests of the country. A teak regeneration improvement programme based on silvicultural characteristics of teak, ecology of the forest and the national forest policy is proposed.

1327 Lamba, G.S. 1945. **Teak regeneration in the Central Provinces**. Indian Forester 71: 346-347.

Teak forests in this province is distinguished into two types ie., dry type and moist type. Several problems requiring solutions and natural regeneration are discussed.

1328 Lamba, G.S. 1945. **The natural and artificial regeneration of teak**. Proceedings of 6th Silvicultural Conference, Dehra Dun. Forest Research Institute, Dehra Dun.

The problem of natural regeneration of teak in Central Provinces under selection-cum-improvement and uniform system was discussed along with results obtained since 1926. The natural regeneration is considered cheaper and advantageous, wherever feasible, and recommends gathering accurate scientific knowledge on the problem. The problem of artificial regeneration is generally discussed.

1329 Laurie, M.V; Parker, R.N; Muthanna, M.A; Venkata Rao, K.R; Murthi, S; Raynor, E.W. 1941. **Artificial regeneration in dry forest types. Papers (I) Artificial regeneration in dry forests in Madras. (II) Artificial regeneration in dry forests in the Punjab. (III) Short note on artificial regeneration in dry forests in the Kadur Forest Division, Sakrepatna Tract. (V) A short note on the methods of regeneration employed in afforesting some of the in dry bare hills in the Chitaldrug District. (VI) Artificial regeneration in dry forests types**. Proceedings of the 5th Silvicultural Conference, Dehra Dun, 1939: 419-436.

Details of operations, species used and costs are given in the papers.

1330 Leete, F.A. 1912. **Pyinmana Forest Division: Teak and bamboos in Burma**. Indian Forester 38(8): 355-380.

Discusses the natural regeneration problems in teak forests of Burma and advocates revision of policy on fire protection and diverting funds for works of improvement. The costs of raising plantations and broadcast sowings vs. line sowings are discussed. He pleads for natural regeneration and silvicultural operations and methods of exploitation to be correlated with age and bamboo flowering.

1331 Lindsay, W.R. 1948. **Growing teak in the Canal zone**. Foreign Agriculture 12(9): 197-198.

A brief report on experiments in cultivating teak in the Panama Canal Zone.Sandy or clay loam soil of good depth and drainage is required as it produces a large and deep root system. For rapid germination, seeds need to be soaked in water for 24 hours.

1332 Long, A. 1955. **Burma teak**. Burmese Forester 5(1): 11-27.

A short account of Burma teak, giving its range and rate of growth and making suggestions for increasing the growth. Methods of encouraging natural regeneration are described and plantation policy discussed.

1333 Maheut, J; Dommergues, Y. 1960. **The teak plantations of Casamance: Yield and biological characteristics of the stands, and maintenance of soil fertility**. (French). Bois et Forests des Tropiques 70: 25-42.

A brief historical account of the plantations is given. Results of the enumeration surveys made in several plantations are presented. Deals with teak litter and the influence of teak stands on soil fertility. Its litter decomposes rapidly and inhibits N-mineralization. Application of mineral fertilizers and the introduction of less exacting species either in a mixture or as an understorey are the measures suggested for the prevention of soil deterioration.

1334 Manning, D.E.B. 1941. **Erosion in the Yomas of the North Pegu Forest Division**. Indian Forester 67: 462-465.

In Burma, forest conditions do not prevent erosion in the drier types of forest that are subject to annual grass fires. Fire destroy the protective vegetation, litter and surface humus, besides pulverizing the surface soil and thus rendering it more erodible. Severe silting occurs in most of the streams. Kyathaung bamboo and earthquakes in 1930 were two reasons for severe soil erosion.

1335 Marjoribanks, G.E. 1927. **How the teak pole forests of Thana are regenerated?** Indian Forester 53(3): 125-131.

The system of management and method of regeneration of mixed teak pole forests of Thana Division, Bombay, are described and costs of planting teak upto 5th year are given, and net financial results from two sample coupes are calculated.

1336 Maung Gale, U. 1959. **Regeneration of teak in Burma**. Proceedings of All India Teak Study Tour and Symposium December 1957-January 1958: 185-187.

The paper describes the behaviour of teak in early stages of development, methods of regeneration comprising both natural and artificial.

1337 Maung Gale, U. 1961. **Regeneration of teak in Burma**. Burmese Forester 11(1): 55-57.

Describes the extent of teak forests in Burma, behaviour of teak in the early stages of development, methods of regenerating teak by natural and artificial methods and role of Kyathaung flowering in regeneration of teak.

1338 Millett, G.V. 1907. **Regeneration of teak forest in Java**. Indian Forester 33(5): 243-252.

Describes the present condition and past treatments of teak forests of Java with detailed notes on natural and artificial regeneration methods.

1339 Morel, J. 1967. **Notes on the territory of Papua and New Guinea**. (French). Bois et Forests des Tropiques 115: 15-31.

A description is given of the forests, the system of exploitation, the organization of the forest service and silviculture. Silvicultural trials are based on natural regeneration and artificial regeneration for species including teak. Problems of improvement of teak and reforestation of savannas are discussed.

1340 Mujumdar, R.B. 1956. **Natural regeneration of teak in Madhya Pradesh**. Proceedings of the 9th Silvicultural Conference, Dehra Dun, 1956. Part 1: 65-68.

Vast areas with adequate reproduction have been successfully regenerated under conversion fellings. Continued fire protection in the moister types results in development of evergreen forest which prevents natural regeneration of teak.

1341 Nair, P.N. 1981. **Natural regeneration of teak in old teak plantations in moist deciduous areas**. Indian Forester 107(3): 155-157.

In a survey in 1977, regeneration was observed after felling of a stand planted in 1905 and surrounded by younger plantations in Konni Division, Kerala. Abundant seedlings were present in areas not affected by wildfires or grazing which was not usual for teak in the moist deciduous zone.

1342 Nicholson, J.W. 1945. **Teak regeneration in Orissa**. Indian Forester 71: 365-367; Sixth Silvicultural Conference, Dehra Dun, 1945.

Teak occurs naturally in some parts of Orissa but is of poor quality owing to dryness of climate and poor soil. About 60 years ago a few teak plantations were formed in dry-type forests in the divisions of Angul and Puri. As natural regeneration has been profuse in the oldest teak plantations, it has been decided that it will be more profitable interplanting teak with other species like bamboo.

1343 Oever, H.Ten. 1909. **Teak seedlings in the natural forest**. Tectona 2: 372-373.

1344 Oever, H.Ten. 1912. **Natural regeneration of teak (*Tectona grandis*)**. Tectona 6: 68-71.

1345 Oever, H.Ten. 1921. **Teak and Hindoos**. Tectona 14: 652-658.

1346 Pande, P.K; Bisht, A.P.S. 1988. **Regeneration behaviour of some tree species of some forested ecosystems**. Journal of Tropical Forestry 4(1): 78-84.

The population structure and regeneration status of tree species in plantations of *Shorea robusta*, *Tectona grandis*, *Eucalyptus* and *Pinus roxburghii* was studied in the demonstration area of New Forest, Dehra Dun. The study was carried out using the quadrat method with 10 running quadrats for teak. The absence of seedlings and saplings of pine, teak and eucalypts showed lack of their regeneration in the area.

1347 Porter, H.J. 1894. **Failure of natural reproduction in the teak forests of the Coimbatore district**. Indian Forester 20(8): 285-287.

Discussing causes of failure of natural reproduction in spite of complete fire protection in Anamalais and recommends working up of the soil under seed trees and ploughing in the seed, dense undergrowth prevents seedling establishment and growth, fire protection even though good for mature trees is no good for teak regeneration and exclusion of cattle is harmful in moist tract in encouraging grub attack. Loosening of soil and removal of undergrowth is recommended.

1348 Prasad, R.C. 1956. **Artificial regeneration of teak**. Proceedings of the 9th Silvicultural Conference, Dehra Dun, 1956. Part 1: p83 .

A brief account of the sporadic work undertaken in the past and of the systematic and more extensive work now planned is given with a note on the Palamau nursery germination technique.

1349 Prasad, R; Mishra, G.P. 1981. **Establishment of natural regeneration with special reference to dying back in dry deciduous teak forests of Sagar (M.P.)**. Indian Journal of Forestry 4(3): 165-172.

Observations were made of the dynamics of root and shoot growth of species including teak each growing on three soil types as part of a study of the effects of dying back on regeneration period. The relation of root/shoot ratio at various ages to dying back is analysed. Some drought mechanisms developed in annual and perennial herbs and climbers are briefly described.

1350 Quint, M.P.L. 1956. **Report on teak in Dahomey**. (French). Proceedings of the 4th World Forestry Congress, Dehra Dun, 1954: 339-342.

1351 Qureshi, I.M. 1951. **Regeneration of flowered bamboo area**. Proceedings of 8th Silvicultural Conference, Dehra Dun, 1951, Part 2: 294-295. Forest Research Institute, Dehra Dun.

Establishment of teak after gregarious flowering of *Dendrocalamus strictus* and *Bambusa arundinacea* in the mixed moist deciduous forests of Kanara, Belgaum and Dangs divisions of Bombay state is discussed.

1352 Qureshi, I.M. 1956. **Natural regeneration of teak in moist deciduous forests of Deccan Plateaux (Bombay state)**. Proceedings of the 9th Silvicultural Conference, Dehra Dun, 1956, Part 1: 68-69.

A general account of unprecedented natural regeneration in the division is investigated.

1353 Rai, L; Datta, R.N. 1952. **Regeneration of the mixed teak forests in Madhya Pradesh**. FAO Asia Pacific Forest Commission FAO/APFC/52/17: 4p. FAO, Rome.

The mixed deciduous teak forests of Madhya Pradesh are described and the problems of regeneration in dry, intermediate and moist type of forests are discussed and suggestions are made on artificial planting of teak.

1354 Regd, J.D. 1917. **Regeneration of teak in the Mungod Pole forest of North Kanara**. Indian Forester 43(4): p197.

Describes regeneration work where teak seedlings are weeded.

1355 Roosendael, J van. 1928. **Natural regeneration of teak**. (Dutch; German). Tectona 21: 257-266; Forest Rundschau 1: p115.

1356 Sagreiya, K.P. 1947. **Natural regeneration of moist teak/bamboo forest**. Report of Forest Department, Central Provinces and Berar 1945-46: 14-15.

The difficulty of obtaining a well stocked two-storeyed forest with teak in the upper storey and bamboo in the lower, is largely due to the different rates of growth of the two species. The system practised in the Central Provinces is described.

1357 Sagreiya, K.P. 1956. **Methods of increasing growth and obtaining regeneration in the deciduous forests of Central India**. Proceedings of the 4th World Forestry Congress, Dehra Dun, 1954, 3: 363-388. (Tropical Silviculture 2, 1957); (FAO Forestry and Forests Products Studies 13: 257-282).

Describes the principal forest types of western Madhya Pradesh, silvicultural methods with special reference to teak, protection and research needs.

1358 Sagreiya, K.P. 1961. **Recent trends in techniques of natural regeneration (teak)**. Proceedings of 9th Silvicultural Conference, Dehra Dun, 1961: 287-292.

Summary of discussions on the subject are given.

1359 Schokker, P. 1910. **Regeneration of teak in the Grobogan forest section**. Tectona 2: 225-266.

1360 Seth, S.K; Khan, M.A.W. 1958. **Regeneration of teak forests**. Indian Forester 84(8): 455-466.

Forests of the teak zone of India are described. Champion's types of teak forest are discussed and proposals made for a revised classification of types, to meet the requirements of intensive management practices followed at present. Factors controlling the occurrence and development of regeneration are detailed and proposals are made for future research to solve the problems of natural and artificial regeneration of teak zone of India.

1361 Seth, S.K; Khan, M.A.W. 1959. **Regeneration of teak forests**. Proceedings of All India Teak Study Tour and Symposium, Dehra Dun: 107-120.

Forests of the teak zone of India are described. Champion's types of teak forest are discussed and proposals are made for a revised classification of types to meet the requirements of intensive management practices at present followed. Factors controlling the occurrence and development of regeneration are detailed and proposals are made for future research to solve the problems of natural and artificial regeneration in the teak zone of India.

1362 Singh, J; Mahajan, A.G. 1998. **Natural regeneration status in Melghat forests - an overview**. Indian Forester 124(4): 186-196.

The Melghat forests of Maharashtra are dominated by teak. The forests are managed by the selection system. The concept of natural regeneration adequacy is discussed and 440 seedlings/ha suggested as suitable. Various ecological factors like nutrient depletion by grass cover and shade from shrubs and bamboos in the understorey and fire reduced establishment. Ways to overcome these problems are briefly discussed.

1363 Sono, P. 1964. **Note on growth of teak seedling in natural forest**. (Siamese). Vanasarn 22(1): 54-66.

It is indicated that 7-29 years were required before seedlings become safe from yearly burnings, a root diameter, u.b., of 18.4 mm. at 25 mm. below ground level seemed critical for mere survival and this represents approximately eight years of growth. The author recommends stump planting.

1364 Spaan, W.J. 1912. **Natural regeneration of teak forests**. Tectona 5: 571-576.

1365 Srivastava, S.S. 1949. **Regeneration of teak both a puzzle and solution**. Madras Forest College Magazine 25(4): 161-166p.

Lists the factors which favour or adversely effect teak regeneration in different types of forest areas.

1366 Stoutjesdijk, J.A.J.H. 1923. **Natural regeneration tests**. Tectona 16: 823-830.

1367 Sumantakul, V; Yingransiri, T. 1979. **Effect of partial on heartwood development of teak (*Tectona grandis* Linn.f.)**. (Thai). Report on Silviculture 1977-78: 85-86. Ministry of Agriculture and Cooperatives, Bangkok. Royal Forest Department, Silviculture Division.

1368 Suttie, W.R. 1960. **Progress report on teak forestry in the Territory of Papua and New Guinea**. FAO Teak Sub-Commission, New Delhi, 1960, FAO/TSC-60/2.7: 5p.

The following aspects are covered. General information, area planted, locality factors, forest types, seed origin, plantation establishment, pests, diseases, protection, rate of growth, rotation and yield.

1369 Swain, S.L; Behera, N. 1998. **Qualitative analysis of vegetation from a regenerating teak forest of Orissa, India**. Journal of Ecobiology 10(1): 13-18.

Vegetational analysis was undertaken of tree species in a regenerating teak forest in Sambalpur, Orissa. On the basis of importance value index, *Tectona grandis* was the dominant species at all the sites except one. The relative contribution of *Tectona grandis* to total IVI varied from 34.8 to 64.5 percent over the sites. Total density ranged from 1670 to 4060 stems/ha and the total basal area from 4.47 to 124.51 m2/ha. There was a trend towards an inverse relationship between diversity and dominance.

1370 Sweet, J.M. 1945. **The natural and artificial regeneration of teak**. Proceedings of the 6th Silvicultural Conference, Dehra Dun. Forest Research Institute, Dehra Dun.

Reports on well-versed Madras experience in artificial regeneration techniques and recommends on collecting from other experience on natural regeneration methods.

1371 Takle, G.G; Majumdar, R.B. 1957. **Increasing growth and natural regeneration of teak**. Tropical Silviculture, FAO Forestry and Forest Products studies 13: 237-256. FAO, Rome.

The paper deals with distribution of teak in Madhya Pradesh with reference to climate, geology, elevation and soil. Teak forests were described with reference to locality factors and Champion's forest types. The suitability of soils for teak forest are discussed and teak is considered as a biotic climax and effect of various biotic factors and silvicultural factors on teak forests are discussed.

1372 Takle, G.G; Mujumdar, R.B. 1956. **Increasing growth and regeneration of teak**. Indian Forester 82(1): 8-21.

Reviews the ecological status of mixed teak forests in Madhya Pradesh, silvicultural methods and the state of natural regeneration.

1373 Tarasingh. 1932. **Notes on regeneration technique in the Central Provinces**. Indian Forester 58(12): 704-712.

The regeneration techniques such as artificial regeneration of teak, the dona planting system and its advantages, firing of the forest to be naturally regenerated with teak and use of Boga and Arhar cover crops for plantations are described.

1374 Thaiutsa, B; Puangchit, L; Yarwudhi, C; Wacharinrat, C; Kobayashi, S. 2001. **Coppicing ability of teak (*Tectona grandis*) after thinning**. Rehabilitation of degraded tropical forest ecosystems. Workshop Proceedings, Bogor, 2-4 November 1999. S. Kobayashi; J.W. Turnbull; T. Toma; T. Mori; N.M.N.A Majid, Eds: 151-155. Center for International Forestry Research, Jakarta.

The research was carried out to determine the effects of different thinning methods on coppicing ability of 17-year-old teak.

Different thinning methods are followed and found that the thinning methods did not affect shoot density, but affected shoot growth. The findings indicate that shoot growth is promoted by wider gaps after thinning due to the light-demanding characteristics of teak.

1375 Thampi, K.B. 1997. **Environmental impacts of teak regeneration and culture**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 262-269. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Kerala plantation forestry has a long history dating to the 1840s when teak planting commenced in the Nilambur valley. Two teak rotations have been completed and planting has been done for the third. The paper discusses the impact of a century and a half of teak plantation on a wide spectrum of the environment including: biodiversity, soil deterioration, soil erosion, climatic changes, wildlife, recreation, stream flow, slash burning, grazing and forest cultural practices.

1376 Thittaw-Wunmin. 1904. **Reproduction of teak in areas of flowered bamboo**. Indian Forester 30(9): 419-421p.

With reference to proposed reorganization of Burma Forest Department, the author discusses and proposes the treatment of Kyathaungwa teak forests, after bamboo flowering, examining administrative problems.

1377 Thorenaar, A. 1941. **On regeneration in combination with agriculture in Bagelen**. (Dutch). Tectona 34: 679-686.

This method of clearing and planting work in the Bagelen district, Java, is owing to the severe erosion that takes place on unprotected sites. The method of planting work followed for the afforestation is discussed in detail. Teak is the most important tree species.

1378 U Saw Tun Aung. 1952. **Regeneration of teak in Burma**. Burmese Forester 2(2): 71-78.

It is presumed that most of the old teak stands in yoma forests originated after gregarious flowering of bamboo. It is suggested that natural regeneration in such stands is inadequate and should be supplemented by stump planting in openings. Wide spacing in partial sunlight will prevent epicormic branching.

1379 U Saw Tun Aung. 1955. **Regeneration of teak in Burma**. Burmese Forester 5(2): 100-107.

A reply to criticisms of the author's views on teak plantations by C. W. D. Kermode.

1380 Venkataramany, P. 1956. **Experiments on coppice regeneration of teak**. Proceedings of the 9th Silvicultural Conference, Dehra Dun, 1956. Part 1: 74-75.

It was found that there was no difference in stool mortality either between high or low stools or between trimmed and untrimmed stools. It was found that by reducing the number of coppice shoots to one per stool, gave best diameter and height growth.

1381 Venkataramany, P. 1956. **Progress of research on the artificial regeneration of teak in the Madras State, 1926 to 1956**. Proceedings of the 9th Silvicultural Conference, Dehra Dun, 1956. Part 1: 75-83.

An account of the experiments undertaken is given with their results and conclusions.

1382 Venkataramany, P. 1960. **Summary of discussions on natural and artificial regeneration of teak**. Proceedings of the 9th Silvicultural Conference, Dehra Dun 1956, Part 2. Forest Research Institute, Dehra Dun.

Gives summaries of the discussions on the subject as presented by various participants.

1383 Walker, H.C. 1904. **Reproduction of teak in bamboo forests in Lower Burma**. Indian Forester 30(2): 51-55; 30: p378.

The works carried out in exploited teak forests by taungya plantations and improvement fellings to aid natural regeneration are described in detail with reference to requirements of teak and locality factors of Burma.

1384 Walker, H.C. 1909. **Reproduction of teak in Burma**. Indian Forester 35(6/7): 367-376.

Reproduction of teak in Burma with reference to bamboo flowering has been discussed with reference to current experiments of natural regeneration.

1385 Westra, J.G. 1921. **Natural regeneration of teak forests**. Tectona 14: 643-651.

1386 White, K.J; Cameron, A.L. 1965. **Silvicultural techniques in Papua New Guinea: Forest plantations**. Division of Silviculture, Department of Forestry, Papua and New Guinea 1: 99p.

A guide to plantation establishment, with instructions on site preparation and chapters on species including *Tectona grandis* with notes on their distribution and ecology, seed collection, nursery techniques, establishment, thinning, pruning, pests, diseases and fire sensitivity.

1387 Wimbush, A. 1920. **Artificial regeneration of teak by sowing**. Indian Forester 46(9): 488-492; 47: p43.

Describes the details of the regeneration method with costs in the Mount Stewart forest of South Coimbatore Division.

1388 Win, U.N. 1951. **A note on Kyathaung (*Bambusa polymorpha*) flowering in Pyinmana**. Burmese Forester 1(2): 52-56.

Opportunity to introduce teak.

Go top

Seeds collection, storage and germination

(See also 0562, 0690)

1389 **Memorandum of teak sowings in flowered bamboo forest**. Indian Forester 13, 1887: 512-516.

The salient features of the system of increasing proportion of teak in two reserves of Tharrawaddy division is given. The method is described in detail and illustrated with examples from Burma experience.

1390 **Stimulating the germination of teak seeds**. Indian Forester 26(6), 1900: p279.

Teak seed placed in a shallow pit 1.5 ft. deep, filled with water and watered every four days found germinated in another five days. In another experiment, seeds soaked in lukewarm water for twenty four hours reported germinated in 12-24 hours in Surat division.

1391 **Teak comparison of seeds from plantation and from natural forests**. Forest Research in India Part II 1954-55, 1955: p74.

There is no significant difference between the two seeds. In Madras state seed is being mostly collected from plantations.

1392 **Teak sorting of seed by size**. Forest Research in India Part II 1954-55, 1955: p74.

There is no significant difference in the mean heights of trees raised from seeds of different sizes.

1393 **Teak: Effect of size, age and condition of seed bearers**. Forest Research in India Part II 1954-55, 1955: p74.

Seed from over mature trees is as good as mature trees and hence seeds can be collected from all trees except immature trees.

1394 **On teak seed germination**. Forest Research in India and Burma 1962-63, Part II, 1963.

In the Subansiri forest division of north east Frontier Agency, seeds were sown in all centres after necessary treatment. The germination percent is 50 and plant percent is 40.

1395 Agboola, D.A. 1993. **Effect of seed size on germination, seedling growth and dry matter accumulation in some tropical tree species**. Malaysian Forester 56(1/2): 61-71.

The rate of germination in *T. grandis* was faster for small seeds than large seeds. The Net Assimilation Rate and the Leaf Area Ratio were higher in seedlings of *T. grandis* raised from large seeds. Relative Growth Rate was higher in seedlings of *T. grandis* raised from small seeds.

1396 Agboola, D.A. 1998. **Effect of saline solutions and salt stress on seed germination of some tropical forest tree species**. Revista de Biologia Tropical 46(4): 1109-1115.

Saline solutions of six salts used had highly significant effects on seed germination in most of the tree species. Sodium sulfate permitted germination of the seeds of *Tectona grandis* presoaked in 0.2 M solution for 48 h. Solution of potassium permanganate favored the germination of seeds of *T. grandis*. Seeds of *T. grandis* were reported salt tolerance.

1397 Agboola, D.A. 2000. **Studies on the germination inhibitors in the fruits of four tropical tree species**. Global Journal of Pure and Applied Sciences 6(1): 27-30.

Aqueous extracts of intact fruits of tree species including *Tectona grandis* contained germination inhibitors, which when applied to guinea corn grains inhibit their germination.

1398 Agboola, D.A; Etejere, E.O. 1991. **Effect of relative humidity during seed storage on longevity of seeds of six forest tree species**. Nigerian Journal of Botany 4: 23-32.

The study include the species *Tectona grandis*.

1399 Agboola, D.A; Etejere, E.O; Fawole, M.O. 1993. **Effect of orientation and soil types on germination of seeds of some tropical forest tree species**. Seed Research 21(1): 13-20.

Germination of *Tectona grandis* was significantly higher in loamy soil than in washed sterile river sand or non-sterile river sand. In *Tectona grandis* germination was significantly slowed down when the hilum/micropyle was inverted.

1400 Armitage, H.P. 1896. **Germination of teak seed**. Indian Forester 22(11): p438.

Reports the Ceylon experience in which, during dry and fine weather, the seeds are spread on ground on a mat 4" thick, constantly watered in sun and germination started in three days. The germinating seedlings are pricked out into nursery, watered twice daily and first pair of leaves appeared in 15 days.

1401 Bagchi, S; Emmanuel, C.J.S.K; Boisson, C. 1983. **Germination studies in *Tectona grandis* Linn.f.** Myforest 19(4): 209-213.

Fruits collected from plus trees in Kerala, soaked and dried once and sown. Germination and numbers of chlorophyll-deficient mutants recorded until 54 days after sowing. Germination varied from 15.5 to 106.7 percent. Seedlings from 5 of the plus trees were chlorophyll deficient or albino. The results suggest that inbreeding is occurring in a normally cross-pollinating species and possible reasons for this are discussed.

1402 Bamrungrars, P. 1964. **Comparison of the germination of seeds soaked in 5 percent of sulphuric acid for different periods**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Results indicated soaking for 40 minutes gives best germination but not significant among the treatments.

1403 Banik, R.L. 1977. **Studies on grading of teak fruits - 1. Fruit size is a factor in germination of teak seeds**. Bano Biggyan Patrika 6(1): 1-7.

The lower germination rate of the smaller fruits appeared to be largely due to their lower seed content. It is recommended that teak fruits of less than 14 mm diameter should not be used in nurseries.

1404 Banik, R.L. 1978. **Studies on grading of teak fruits. II. Combined effect of fruit weight and size in the production of seedlings**. Bano Biggyan Patrika 7(1/2): 20-29.

Results of germination tests showed that size is the primary factor determining quality through its relation with seed number demonstrated earlier.

1405 Bannerjee, K.K. 1942. **An attempt on quick germination of *Tectona grandis* seeds**. Indian Forester 68: 240-244.

The method include after 36 hours of soaking in a pond, the seeds are spread on bamboo mats and are watered. Some 50 percent found germinated.

1406 Bapat, A.R; Phulari, M.M. 1995. **Teak fruit treatment machine - a prototype - II**. Indian Forester 121(6): 545-549.

This paper describes a second prototype of fruit treatment machine, which enables the easy, rapid and cheap processing of batches of 10-13 kg of pre-soaked fruits.

1407 Barrantes, G; Salazar, R. 2000. **Commercialization of seeds in the forestry seed bank of the Agricultural Centre of the Hojancha Area (CACH)**. (Spanish). II Simposio sobre avances en la produccion de semillas forestales en America Latina: Memorias, Santo Domingo, Republica Dominicana, 18-22 de octubre 1999: 243-247. Centro Agronomico Tropical de Investigacion y Ensenanza (CATIE); Turrialba; Costa Rica .

Between March 1997 and May 1999, 19,777 kg seeds were available from the CACH seed bank at Guanacaste, Costa Rica. The most demanded species were *Tectona grandis* of 13,173 kg.

1408 Bedell, P.E. 1989. **Preliminary observations on variability of teak in India**. Indian Forester 115(2): 72-81.

The results are given of pretreatment and germination studies with thirty six Indian seed provenances. Treatments tested included alternate soaking in water and drying for 1 month, soaking in Sach's nutrient solution and drying for one month and no treatment.

1409 Bedell, P.E; Vijayachandran, S.N. 1994. **Observations on fruit and seeds of individual clones of Walayar teak seed orchard**. Journal of Tropical Forestry 10: 107-113.

1410 Bhumibhamon, S. 1973. **Seed problems in Thailand**. IUFRO Symposium, Bergen, Norway, 4-14 September 1973: 17p.

The paper describes seed problems of species used in afforestation and reforestation programmes of Thailand and factors like age of trees, vigour, and other environmental factors influencing the production of seeds. The existing methods of seed collection, processing, extraction and storage for various species are described. Work done and research projects at the Thai-Danish Teak Improvement Centre, specially on teak seed storage, germination methods and seed orchard are also discussed.

1411 Bhumibhamon, S; Ponoy, B; Chaisurisri, K. 1981. **Germination complex of teak fruits**. (Spanish; English). Instituto Nacional de Investigaciones Forestales, Mexico 35: 253-264.

Fruits were collected from five natural stands in Thailand. Fruits damage, fruits weight, number of seeds/fruit, seed size and germination percent is reported for seed from 1-, 2-, 3-, or 4-seeded fruits. Aqueous or alcohol extracts of teak fruit mesocarp inhibited the germination of rice grains and pine seed, indicating the presence of a phytocide.

1412 Bingchao, K. 1995. **Relationship between teak seeding density and seedling yield and quality**. Forest Research, China 8(4): 351-359.

1413 Blanford, H.R. 1921. **Preparation of teak seed for early germination**. Burma Forest Bulletin 1 (Silviculture Series): 7p.

Describing the methods followed by M/s Dawkins, Milner and Moodie buried seed shows good results. The time and method of dibbling buried seed is recommended. Soaking in a stream for 10 days in sacks as a last resort and burying for one month and dibbling seed is recommended.

1414 Blanford, H.R. 1931. **Experiments in connection with sowing and planting teak in taungya plantations**. Burma Forest Bulletin 24 (Silviculture 14): 15p.

Discussed the results of the experiments done to examine teak sowings in different nursery sites, different times of sowing and with different seed pretreatments to promote early germination. Another series of experiments are carried out by direct sowing and planting in taungya plantations.

1415 Boonkird, S. 1973. **Germination test on teak seeds from fertilized and unfertilized mother trees**. Proceedings of IUFRO Seed Symposium, Bergen, Norway, 4-14 September 1973, II Paper 3: 1p.

It was observed that germination percentage of the seeds from the unfertilized mother trees were 24.6 percent, 24.8 percent and from fertilized plots varied from 32.4 percent, 33.6 percent and 37.8 percent.

1416 Boonkird, S. 1973. **Germination test on seeds from V-4-clone at Mae-Moh teak seed orchard**. Proceedings of IUFRO Seed Symposium, Bergern, Norway, 4-14 September 1973, II, Paper 4: 1p.

Seeds from V-4 clone in a 5 year old seed orchard of Teak Improvement Centre at Mae-Huad, Ngoa, Thailand, were used in a four replicate randomized block germination test gave an average germination of 51.8 percent.

1417 Boonmuang, B. 1961. **Germination of teak seeds buried at different depths and comparison of their growth**. Student Thesis. Kasetsart University, Bangkok.

Seed sown on surface of seed bed, just below surface and 2.5 cm below surface indicated surface sowing is best with 9.9 percent germination and below surface 5.3 percent and completely buried 1.8 percent germination. Growth of the three treatments are 18.7 cm, 15.7 cm and 9.10 cm respectively.

1418 Boonyasirkul, C. 1964. **Comparison of germination of teak seeds after soaking in various different concentration of acid**. (Thailand). Student Thesis. Kasetsart University, Bangkok.

The results indicated treatment with different acids or using different concentrations for treatment is not different from water treatment as far as germination is concerned.

1419 Bourke, D.R.S. 1914. **Germination of teak seeds**. Indian Forester 40(10): p519.

The author suggests that teak seed improves and germinates better by keeping for one or two years. Describes an experiment with profuse germination of two years old stored seed.

1420 Bryndum, K. 1966. **The germination of teak**. Natural History Bulletin of the Siam Society 21(1/2): 75-86.

The Teak Improvement Centre experiments on the germination of teak and programme of work for the Thai-Danish Teak Improvement Centre, at Mae-Huad, Northern Thailand are described. Discusses the slow and sporadic germination of teak seed and gives results of nursery experiments showing that the germination rate can be increased considerably by removing the exocarp from the fruit.

1421 Butranar, M. 1962. **Germination rate of teak seeds determined by oven method of various temperatures**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Results of the experiments carried out with different oven temperatures using seed size of 11.5 mm are presented here. The average germination is 6.39 percent and average survival of seedlings is 99.13 percent.

1422 Caldeira, S.F; Mendonca, E.A.F de; Diniz, N.N. 2000. **Characterization and quality evaluation of teak (*Tectona grandis* Linn.f.) fruit produced in Mato Grosso, Brazil**. (Portuguese). Revista Brasileira de Sementes 22(1): 216-224.

Fruits of 13 seed lots of *T. grandis* from three seed producing areas from Brazil were characterized. Properties of moisture content, fruits weight and number of fruits per kg are studied. The lots showed an average of 1/3 of fruits with no seeds and 74.3 percent with one seed.

1423 Chacko, K.C. 1998. **Termite aided mesocarp removal of teak (*Tectona grandis* Linn.f.) fruits for enhanced germination and cost-effective seed handling**. Indian Forester 124(2): 134-140.

Termite-aided mesocarp removal of teak fruits is an efficient pre-sowing treatment for early and enhanced germination. In a test at Kerala Forest Research Institute, fruits were left heaped in open-ground infested with subterranean termites, *Odontotermes guptai*, mixed with dry twigs and kept sufficiently moist. The termites ate away the entire mesocarp within 13 days leaving behind fruits with a stony endocarp.

1424 Chacko, K.C; John, S.K; Asokan, A.M. 1997. **Evaluation of some pre-sowing treatments for germination of teak (*Tectona grandis* Linn.f.) fruits**. Annals of Forestry 5(1): 55-61.

The treatments included alternate wetting and drying for 2-7 days, soaking in cowdung solution followed by storage in wet gunny bags, boiling in water and cooling and steaming under open and closed conditions. The effect of paddy straw and twigs of amla as mulching materials on seedbeds were also compared. Wetting and drying for 7 days and soaking in cowdung solution for 24 hours are recommended for enhancing germination of teak fruits.

1425 Champion, H.G. 1933. **Germinating teak seed**. Indian Forester 59(3): p191.

Reported the case of the method evolved for germinating teak seed at the Forest Research Institute, Dehra Dun.

1426 Chantrakaew, K. 1963. **Study of germination percentage of teak by soaking in running water for various periods**. (Thai). Student Thesis. Kasetsart University, Bangkok.

No germination has been reported in the case of soaking in running water for 20 days and for 15 days. 0.5 percent germination got in the case of soaking in running water for 10 days and for 5 days gave 2.5 percent germination and control in running water for 5 days gave 15.75 percent germination.

1427 Chaplin, G.E. 1988. **Notes on seed testing techniques for six major species**. Forestry Division, Solomon Islands, Forest Research Note 56-23-88: 6p .

Techniques for germination testing, pretreatment required and germination characteristics and problems are described for species including *Tectona grandis*.

1428 Chaplin, G.E; Gua, B.E; Poa, D.N. 1987. **Seed production of seven major plantation species since 1984: Implication for future objectives**. Forest Division, Solomon Islands, Forestry Note 19-3-87: 5p.

Data on seed collection and seed sources and stands are given for seven major Solomon Islands species including *Tectona grandis*. The implications for future seed supply are discussed and the importance of improvements in seed quality emphasized.

1429 Charoenphaibool, W. 1962. **Comparison of the germination of teak seeds soaked in different concentrations of Acetic acid**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The control and 1 percent concentration treatment are significantly different from 20 percent and 30 percent concentration treatments.

1430 Chaturvedi, M.D. 1942. **Germination of teak seed**. Indian Forester 68: p457.

A method is described for hastening the germination of teak seeds by spreading them on a 1-inch-thick layer of coarse sand resting on loosely packed grass and twigs over a brushwood foundation, and then covering the seed with a thin layer of rich forest soil. The bed is soaked with water every evening.

1431 Chen, C.T; Yang, K.C. 1969. **Experiment on hastening germination of teak seeds**. (Chinese). Quarterly Journal of Chinese Forestry, Taipei 2(2): 59-65.

Treatment with hot sand gave a mean germination of 44.5 percent, alternate soaking and drying 29.5 percent, scarification of the pericarp 20.8 percent, storage in the ground 18.8 percent and controls 9.4 percent germination.

1432 Chobkai, S. 1962. **Comparison of the germination of teak seeds soaked in different concentration of Sulphuric acid**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Teak seeds soaked in sulphuric acid 10, 20, 30, 40 percent concentration gave very good germination with 10-20 percent concentrations but there is no significant differences between other treatments and control.

1433 Choldumrongkul, A; Pipitvitaya, S; Ratanaporncharern, W. 1999. **Germination of teak (*Tectona grandis* Linn.f.) pollen from different crown directions**. (Thai). Kasetsart Journal, Natural Sciences 33(3): 330-334.

Germination of teak pollens collected from different crown directions of north, south, east, west and in the central part of the crown were investigated. Germination percentage of pollen collected from southern direction was lowest.

1434 Chuntanaparb, L. 1962. **Comparison on the germination percentage between different size of teak fruits gathering from Prae an Lampang**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Two seed lots of 2500 seeds from each provenance were divided into five seed class sizes (1) below 8 mm; (2) 8-11 mm; (3) 11-14 mm; (4) 14-17 mm; (5) 17 mm and over. The seed from Prae provenance is not significantly different for different classes and in Lampang seed lot size class 17 mm and over is best for germination.

1435 Dabral, S.L. 1976. **Extraction of teak seeds from fruits, their storage and germination**. Indian Forester 102(10): 650-658.

A method of extraction is described that uses a modified nut-cracker to split the teak fruit in four longitudinal planes. Fungicide-treated seeds gave 54 percent germination after two months storage. Seeds germinated at temperatures between 25 deg C and 40 deg C, with an optimum at 30 deg C. Soaking of seeds before sowing reduced germination.

1436 Dabral, S.L. 1976. **Emptiness in teak (*Tectona grandis* Linn.f.) fruits**. Indian Forester 102(4): 247-253.

Fruit development from flowering to fruit maturity was studied on teak trees in Chandrapur district, Maharashtra. Fertilized fruits in the early stages of development contained an ovule in each locule. Emptiness developed at the time of lignification of the endocarp and was not related to locule size.

1437 Damale, D.N. 1901. **Germination of teak seed**. Indian Forester 27(10): p553.

A short note on a method of germination of teak in hill-lands without watering the seed or seedlings. One year old seed is sown in well pulverised earth in May germinates with first downpour of rain within a week. Seedlings though leaf less in hot season do not die.

1438 Darmono, R; Corryanti, T.W.N. 1996. **The effect of long-term storage of teak seeds, testing of methods**. (Indonesian). Duta Rimba 20(187/188): 38-46.

Germination tests were carried out in open nursery beds at Mae Tha Seed Orchard after five storage treatments like keeping the seeds in jute and storing under a shed, keeping in a sealed container in a cold room, keeping in aerated bags in a cold room, keeping in a sealed container in a seed storage room and keeping in aerated bags in a seed storage room.

1439 Das, G. 1896. **Germination of teak seed at Jodhpur**. Indian Forester 22(9): p353.

Seed buried in a pit, taken out and sown in nursery and watered, which germinated and seedlings have come up.

1440 Denoga, A. 1936. **On germination of teak (*Tectona grandis*, Linn. F.)**. Makiling 15(2): 1936-1937.

1441 Denoga, N. 1939. **Germination of teak**. Philippine Journal of Forestry 2: 173-183.

The best results were obtained with surface sowing, soil treatments with 1 part ash to 2 or 5 parts clay-loam, and seed storage for 20 to 60 days in shaded pits.

1442 Dent, T.V. 1948. **Seed storage with particular reference to the storage of seeds of Indian forest plants**. Indian Forest Records (n.s.) 7(1): 124p.

Gives a comprehensive account on all aspects of seed storage together with a discussion on the important items of seed storage, seed viability, dormancy, germination and testing of seed. Teak is one of the many species included.

1443 Dharmalingam, C; Masilamani, P. 1997. **Radiography technique for testing the quality of teak (*Tectona grandis* Linn.f.) seeds**. Bangladesh Journal of Forest Science 26(2): 51-55.

Teak drupes from Tamil Nadu and Thailand differed in size and weight both within and between seed lots. Radiographs showed the occurrence of 4, 3, 2 and 1 seeds in the tetracarpillary ovary in the frequency of 1, 5, 19 and 48 percent respectively with 27 percent empty drupes.

1444 Dhyansagar, V.R; Kothekar, V.S. 1982. **Problem of teak seed germination**. Indian Journal of Forestry 5(2): 94-98.

Seeds in lots of 200 were irradiated with 0, 10, 15 or 40 kR doses of gamma rays and sown in the field. Germination percentages were 8-10, 25, 30 and 20 respectively. The population raised from treated seeds showed chlorophyll chimaeras and a broad spectrum of morphological variations.

1445 Dontri, S.I. 1962. **Study of the germination of teak seeds in sand with different level of Calcium application**. (Thai). Student Thesis. Kasetsart University, Bangkok.

1446 Dontri, S.I. 1970. **Teak seed treatment by soaking in water**. Proceedings of the 3rd National Forestry Conference, Bangkok.

1447 Duangratana, K. 1966. **Study on the germination of teak fruits and growth of seedlings under different intensities of light**. (Thai). Student Thesis. Kasetsart University, Bangkok.

1448 Eidmann, F.E. 1923. **Practical results of germination on research in teak and several other timbers**. Tectona 26: 423-426.

1449 Eidmann, F.E. 1934. **Germination of teak (*Tectona grandis* Linn.f.)**. (Dutch; German). Tectona 27(4): 233-287.

Influence of the age and quality of mother trees and size of fruit upon seed quality and ease of germination was investigated in Java. Data on yield of fruits, size and their germination in different months was given and recommendations are made on seed storage and viability was observed to last for one year.

1450 Emmanuel, C.J.S.K; Dharmaswamy, S.S. 1991. **Seed source variation in storage life of teak seeds**. Silvae Genetica 40(5/6): 249-250.

Seeds of teak of Karnataka, Kerala and Tamil Nadu were stored under three different conditions: cold storage at 5°C, storage in a gunny bag and storage in a polyethylene bag. Storage in polyethylene bag gave the best results for seeds from Tamil Nadu and Kerala and germination of Karnataka seeds was similar for all three storage methods.

1451 FAO. 1955. **Tree seed notes: Part 2 *Tectona grandis***. FAO Forest Development Paper 5: 337-339.

Gives notes on teak along with other species.

1452 FAO. 1975. **Report on the FAO/DANIDA training course on forest seed collection and handling, Chiang Mai, Thailand, 17 February-13 March 1975. 2 vols**. 453p. FAO, Rome.

Covered theoretical and practical aspects of seed collection and handling. Lectures were on forestry in Thailand, flowering and seed development, seed collection, seed extraction, storage and testing, improved seed sources and seedbeds and sowing. Case studies are presented on different species including *Tectona grandis*.

1453 Ferguson, J. 1877. **Memorandum on growing seedlings from teak seed planting out etc**. Indian Forester 3(2): 112-113.

1454 Ferraz AC de, O; Dal Fabbro, I.M; Silva J.M da; Amaral R do; Rodrigues, A.L.G; Penteado, S.R. 1998. **Design of a processing machine for teak fruits to extract seeds**. (Portuguese). Engenharia Agricola 18(1): 52-58.

The machine was designed based on the physical properties of the fruit. The system is able to crack 13 kg of fruit per hour. Construction details as well as capacity are presented.

1455 Forest Department, Papua and New Guinea. 1959. **Storage of teak seed**. Report of Department of Forestry, Papua and New Guinea 1959/60: 26p.

An experiment was made to measure rate of fall in viability. Preliminary results indicate that germination begins to fall after storage for 6 months.

1456 Forest Department, Trinidad and Tobago. 1954. **Germination tests**. Report of Forest Department, Trinidad and Tobago 1952: 15-16. Forest Department, Trinidad and Tobago.

Germination tests of 13 species were made on sterile blotting paper in Petri dishes. Teak gave poor results but good correlation between laboratory and field percentages of germination was obtained. Seed in a glass jar with $CaCl_2$, or in a refrigerator gave good results.

1457 Garudachellam, C.P. 1915. **Germination of teak seeds**. Indian Forester 41(10): p383.

Reported the method of seed germination of teak by soaking in water.

1458 Ghosh, R.C; Singh, R.P. 1973. **Production forestry and role of seed management-a report on India**. Proceedings of IUFRO Seed Symposium, Bergen, Norway, 4-14 September, Vol. II Paper II: p13. Royal College of Forestry, Stockholm.

A country report on India giving teak forestry achievements and seed problems and measures taken by forestry service to meet the huge demands of seed for plantation forestry. It is reported that upto 1968-69 in India 2,85,500 ha. of teak plantation were raised and a planting target of 70,000 ha. was put for 1974-79 plan period.

1459 Gopal, M; Pattanath, P.G; Adarsh Kumar. 1972. **A comparative study of germination behaviour of *Tectona grandis* of some Indian provenances**. Proceedings of Symposium on Man-Made Forests in India, 8-10 June 1972, Society of Indian Foresters, Dehra Dun. Forest Research Institute, Dehra Dun.

The morphological variations and physiological differences that affect germination capacity of teak seeds of five Indian provenances have been recorded and pretreatment for the improvement of germination has been prescribed.

1460 Gopikumar, K; Mahato, K.C. 1993. **Germination and growth behaviour of selected tree species in the nursery**. Indian Forester 119(2): 154-156.

Sixty nine percent germination was recorded for *Tectona grandis*. Girth growth was the least variable parameter between seedlings. Height and number of leaves were significantly correlated with root length and numbers.

1461 Grewal, J.S; Kumar, A; Gaikwal, S.R. 1993. **Teak fruit treatment machine - a prototype**. Indian Forester 119(3): 252-254.

A machine is described that has been developed by Maharashtra Van Sanshodhan Sanstha for removing the mesocarp from teak fruits before sowing. The treated fruits can then be stored.

1462 Gupta, B.N; Kumar, A. 1976. **Estimation of potential germinability of teak (*Tectona grandis* Linn.f.) fruits from twenty three Indian sources by cutting test**. Indian Forester 102(11): 808-813.

Sun dried teak fruits from twenty sources were broken with a light hammer. Empty fruits formed the largest group. Among fruits with seeds, the majority contained only one; 3- and 4-seeded fruits were relatively rare.

1463 Gupta, B.N; Pattanath, P.G. 1975. **Factors affecting germination behaviour of teak seeds of eighteen Indian origins**. Indian Forester 101(10): 584-588.

Reports the results of four treatments: control, soaking in water, soaking in Sachs nutrient solution and removing the mesocarp but leaving the endocarp intact - on the emergence of seedlings from fruits of *Tectona grandis*. Treatment with nutrient solution increased seedling production by 6 to 53 percent, soaking in water also increased seedling production.

1464 Gupta, J.N. 1937. **Seed weights, plant percent for forest plants in India**. Indian Forest Records 11(5).

1465 Hardjowasono, M.S. 1931. **Weight and volume of various species of fruits and seeds**. (Dutch; English). Tectona 24(4): 382-402.

The weight of 1000 teak fruits is reported as 562 to 631 g. and volume 1.920 to 2.210 cm3. The number of seeds per Kg. vary from 1600-1800 and per litre 450-520 or per kerosene tin from 8400-9650.

1466 Hardjowasono, M.S. 1942. **Weight and volume of fruits and seeds**. Tectona 36 (1943): p382.

1467 Hodgson, C.M. 1900. **On pretreatment and germination of teak**. Indian Forester 26: p279.

Slight charring has been found to stimulate germination. Soaking for 24 hours in luke-warm water prior to sowing induced germination in 12-24 hours. Another method consists in filling a pit with alternate layers of seeds and earth 1" thick, cover it with earth and kept it well drenched with water for a fortnight and watered until germination begins. A successful method in Ceylon is to spread seed in layers of 4" thick on a mat and keep it constantly watered, germination starts in 3 days, and the germinating seeds are removed daily and sown in the nurseries.

1468 Holmes, C.H. 1954. **Seed germination and seedling studies of timber trees in Ceylon**. Ceylon Forester 1(3): 3-51.

Data of the germination tests are presented for teak and several other species such as germination periods and growth rate of seedlings.

1469 Hossain, M.K; Khan, B.M; Koirala, B. 2001. **Effect of presowing treatments on *Tectona grandis* Linn.f. seeds and initial seedling development in the nursery**. Proceedings of the IUFRO Joint Symposium on Tree Seed Technology, Physiology and Tropical Silviculture, Laguna, Philippines, 30 April-3 May 2001. Connor, K; Beardmore, T; Tolentino, E.L; Carandang, W.M., Eds: 23-28. Training Center for Tropical Resources and Ecosystems Sustainability (TREES), Laguna.

It is reported that seeds soaked in concentrated sulphuric acid for seven minutes followed by cold water washing provides the highest germination. This was followed by 48 percent and 44 percent germination in seeds treated with concentrated sulphuric acid for five minutes and soaking the seeds in cold water for 48 hours following wet pit storage for 12 days respectively.

1470 Howard, S.H; Champion, H.G. 1928. **Note on weights of seeds**. Indian Forest Bulletin 41.

Gives the seed weight and plant percent for teak and other important Indian tree species.

1471 Hung, L.B. 1958. **Preliminary study on the seed of teak**. Bulletin of Taiwan Forest Research Institute 59: 10p.

Studies were made on the number of seeds per nut, their germination and survival. The mean number of seeds per 100 nuts was 171 and the mean weight of 100 nuts 67.5 g.

1472 Indira, E.P; Chand Basha, S. 1999. **Effect of seeds from different sources on germination and growth in teak (*Tectona grandis* Linn.f.) nursery**. Annals of Forestry 7(1): 39-44.

Nursery experiments conducted at the Kerala Forest Research Institute nursery showed significant differences between and within seeds collected from four groups of teak trees such as plus trees, plantation trees, seed stands and seed orchards with regard to percentage germination and production of total and plantable seedlings. There were highly significant correlations between percentage germination and total and plantable seedlings.

1473 Indira, E.P; Chand Basha, S; Chacko, K.C. 2000. **Effect of seed size grading on the germination and growth of teak (*Tectona grandis*) seedlings**. Journal of Tropical Forest Science 12(1): 21-27.

The effect of size grading of teak seeds collected from natural forests, plantations, seed stands and orchards and plus trees on seedling production and growth was studied at the Kerala Forest Research Institute. The nursery experiments showed that seed size did not have any influence on seedling survival and growth. But seeds of 9 mm diameter had a low germination percentage.

1474 Indira, E.P; Chand Basha, S; Chacko, K.C; Krishnankutty, C.N. 2001. **Effect of different sowing methods and seed rates on germination and growth of teak seedlings**. Indian Journal of Forestry 24(1): 93-96.

The paper presents the result of an experiment conducted at the Kerala Forest Research Institute to study the effect of sowing methods and seed rate on germination and growth of teak seedlings. Broadcasting was found better than dibbling. The study also revealed that there is no significant difference between five seed rates tested with regard to percentage of germination beyond a limit, total and plantable seedlings. Seed rate reduces the survival rate.

1475 Jagat Singh. 1925. **The germination of teak seed**. Indian Forester 51(8): 421-422.

Reports on a successful method of germination by burying the seed in a pit for a period of one year. Bottom of the pit covered with straw and leaves and then filled with Burma teak seed covered again with straw and leaves and closed. Coating of the seed was eaten away and after soaking for 24 hours and sowing in May end germination was over 95 percentage.

1476 Jagat Singh. 1926. **The germination of teak seed**. Indian Forester 52(1): 30-32.

Replies to Mr. Tuggersee on objections for pit method of treatment in heavy rainfall areas and considers open air Kanara method is expensive and also advocates transplanting method over direct sowings on considerations of economy of seed and finances.

1477 Jalil, P. 1994. **Effect of storage containers on the viability of *Tectona grandis* seeds from different provenances of Madhya Pradesh**. Vaniki Sandesh 18(4): 32-37.

It is found that teak seeds retained viability for longer and germinated better when stored in air-tight metal containers rather than in loose bags. Germination increased over the first six months of storage and then started decreasing. Seeds collected from more moist localities had a higher initial germination percentage but lost viability faster.

1478 Jalil, P; Shukla, P.K. 1994. **Growth performance of teak (*Tectona grandis*) seedlings raised from the seeds of improved genetic resources**. Vaniki Sandesh 18(1): 1-5.

In Madhya Pradesh.

1479 Jayasankar, S; Babu, L.C; Sudhakara, K; Unnithan, V.K.G. 1999. **Provenance variation in seed and germination characteristics of teak (*Tectona grandis* Linn.f.)**. Seed Science and Technology 27(1): 131-139.

A trial of teak from seven provenances in Kerala was established at Vellanikkara, Kerala. Seed size varied significantly among provenances and Parambikulam recorded the highest values. Konni recorded the highest germination percentage, peak value and mean daily germination. Heritability was the highest for germination percentage followed by seed weight.

1480 Jones, N; Das, S. 1979. **A programme for the procurement of improved forest tree seeds in Bangladesh**. Bano Biggyan Patrika 8(1/2): 71-80.

Progress during 1976-79 in the selection of seed stands and provisional plus trees, mapping of the natural distribution of the four indigenous species and the establishment of clonal seed orchards of G. arborea and *T. grandis* are described.

1481 Kaewkamnerd, W. 1962. **Comparison of the germination of teak fruits soaked in different concentrations of Hydrochloric acid**. (Thai). Student Thesis. Kasetsart University, Bangkok.

1482 Kaewsingha, A. 1963. **Effect of gamma ray irradiation on the germination of teak seeds**. (Thai). Student Thesis. Kasetsart University, Bangkok.

A seed lot of 1400 seeds were treated with gamma rays from 60 source activity - 20 curies with strengths of 5, 10, 20, 40, 60 and 100 thousand (Roeutgens) R. The germination percent of seed lot treated with gamma rays after sowing are highly significant after 65 days and for others, 32.5, 26, 25, 19.5, 12.5 and 7.5 percentages respectively for irradiated seed.

1483 Kalshoven, L.G.E. 1922. **Notes on forest zoology: 2. Teak fruits spoiled by birds and mammals**. (Dutch). Tectona 15: 684-693.

Among birds, green parrots, small and large squirrels, monkeys, mice, rodents are listed to be causing damage to teak fruits either on top of tree or after falling to the ground.

1484 Kamra, S.K. 1973. **Forestry seed problems of some developing countries in Asia**. Sri Lanka Forester 11(1/2): 5-12.

Discusses the problems of obtaining good-quality seed of the various important tree species including teak in India, Sri Lanka, Bangladesh, Thailand, Korea and the Philippines. The most important problems concern seed testing, seed certification and seed storage and stressed the need for international action to provide financial and technical assistance.

1485 Kamra, S.K. 1973. **X-Ray radiography of teak seed (*Tectona grandis*. L.)**. Proceedings of IUFRO Working Party S2.01.06 on seed problems, International Symposium on seed processing, Bergen, Norway 4-14 September 1973: 13p.

This investigation was performed to find out if X-ray radiography could be utilized for determining the number of seeds in the fruit of teak and for studying their degree of development. The radiographs showed that the number of seeds in the fruit could be determined reliably from them. On an average about 48 percent of the fruits contained one fully developed seed and about 16 percent two such seeds. Seeds were classified into fully developed, medium developed and poorly developed or rudimentary.

1486 Kamra, S.K. 1989. **Collecting, processing, testing and storage of forest seed**. Strengthening the capacity of forest seed production and supply in Vietnam, VIE-86-026, Field Document 2: 66p. Food and Agriculture Organization, Rome, Italy.

Gives the details of different species including teak.

1487 Kamra, S.K; Meyer, W.W; Wegelius, C. 1973. **Stereo-radiography for increased information and accuracy in seed quality testing**. Proceedings of IUFRO Working Party S2.01.06 on Seed Problems, International Symposium on Seed Processing, Bergen, Norway 4-14 September 1973: 8p.

This paper describes the Stereoradiographic technique as a supplement to the X-ray contrast method in seed quality testing. The technical details of method, x-ray film used, exposure time and apparatus are described.

1488 Kandya, A.K; Kandya, S; Turnbull, J.W. 1990. **Seed research on *Tectona grandis* in India**. Tropical tree seed research. Proceedings of an International Workshop, Forestry Training Centre, Gympie, Australia, 21-24 August 1989. ACIAR Proceedings Series 28: 142-146.

A review of the literature since 1900, divided into sections on presowing treatments, provenance trials, emptiness of fruits and seed requirements for plantation programmes.

1489 Kayarnkit, C. 1967. **Germination rate of teak fruits gathering from different age class of mother trees**. (Thai). Student Thesis. Kasetsart University, Bangkok.

1490 Keiding, H; Knudsen, F. 1974. **Germination of teak seed in relation to international provenance testing**. Forest Tree Improvement, Arboretet Hoersholm 7: 19-29.

Reports results of germination tests in Denmark on two provenances of *Tectona grandis* seeds from India. It is found that germination varied with the treatment given: seeds soaked for 48 hours gave better germination than those soaked for 72 hours and seeds with the exocarp removed gave better germination than those with the exocarp intact. There were marked differences between the provenances in the germination.

1491 Kharkhong, S. 1963. **Study of teak seed germination by oven-heated, treatment for different periods**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Oven heated seeds at 50 degree C for 1, 2, 3 and 4 hours, then soaked in cold water for 4 hours. Sown in sand and germinated as below 26.5 percent, 24.25 percent, 32.75 percent and 25.75 percent.

1492 Khayankit, Ch. 1967. **Determining the seed germination and seedling survival in different age classes of teak plantations**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Seeds from 5, 10, 15, 20 and 24 years aged stands were used and indicated 20 years has the highest germination of 49.2 percent and 10 years has the lowest germination of 29.6 percent.

1493 Koshi, S. 1993. **Teak fruit germination - some basic studies**. Delhi, University of Delhi: 54p.

Teak fruit germination has been a vexed problem for forest departments. Several pregermination treatments have been evolved to promote teak fruit germination in the nursery. A study of relative efficacy of some twelve germination treatments are examined.

1494 Kramer, F. 1932. **An investigation of the germination of teak**. (Dutch; German). Tectona 25(1): 1-24.

1495 Krishna Murthy, A.V.R.G. 1973. **Problems of teak seed -1. Flower and fruit studies**. Proceedings of IUFRO Symposium on Seed Problems, Bergen, Norway, 4-14 September 1973, Vol. II, 20: 17p.

A review paper on teak summarising the knowledge of biology and physiology of teak flowering and fruiting, seed collection, seed storage, and related matters, with special reference to their effect on viability and germination potential of teak seed are discussed and research to be undertaken is outlined.

1496 Krishna Murthy, A.V.R.G. 1973. **Problems of teak seed-2. Germination studies**. Proceedings of IUFRO Symposium on Seed-Problems Bergen, Norway, 4-14 September, Vol.II, 21: 24p.

A review paper on germination of teak fruit and germination problems as effected by seed dormancy and after-ripening process, pre-sowing treatment, intensity of sowing, method of sowing and position of seed in seed bed, seed weight, seed diameter, viability of stored teak seed in relation to weight and diameter and effect of other factors like light, temperature, thickness of covering and age of mother tree etc. are discussed.

1497 Kulpracheep, Ch. 1963. **A comparison of the germination of teak seeds soaked in different concentrations of Hydrochloric acid**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Germination of 7.75, 15.75, 27.5, 9, 9.5 percentage was obtained respectively for control, 20, 15, 10, 5 percent concentration of Hydrochloric acid.

1498 Kumar, A. 1979. **Effect of fruit size and source on germination of teak (*Tectona grandis* Linn.f.) seeds**. Sri Lanka Forester 14(1/2): 58-63.

Fruits from five sources in Andhra Pradesh were graded by size and sown in moist sand. Cumulative germination is found increased with increasing fruit size in two provenances but showed no clear relation in the other three provenances.

1499 Lacharoch, S. 1963. **Comparison of the germination of teak seeds by soaking in different concentration of Acetic acid and planting them in two different media**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Germination of treated seed sown in clay is better than sand. Germination percent of seed treated with acetic acid is significant. Treatments studied are control, 2.5, 5, 7.5 and 10 percentage concentrations.

1500 Linden, A van der; Gonzalez Daimiel, A.P. 2000. **Status of the certification of forest seeds in Costa Rica**. (Spanish). Revista Forestal Centroamericana 32: 26-29.

Described he certification process for forest seeds as well as quality control methods for teak and *Gmelina arborea*.

1501 Liu, W.M; Liang, K.N; Pan, Y.F. 2001. **Effect of gibberellin on germination of teak**. (Chinese). Forest Research, Beijing 14(1): 41-46.

At a temperature of 35°C, gibberellin improved seed germination rate and speed. In the dark, a low concentration of gibberellin resulted in a higher germination rate.

1502 Mackenzie, J.A; Jones, N. 1998. **Towards synchronous germination of teak**. Workshop on Teak Seed, Tropical Forest Research Institute, Jabalpur, 28-31 May 1998.

1503 Mannan, M.A. 2000. **Studies on seed production, germination and storage of some plantation species in Bangladesh**. Bangladesh Journal of Forest Science 29(1): 61-66.

A study was conducted on 69 plantation tree species in Bangladesh to investigate their seed harvesting time, production, germination and storage. Seed pre-treatment was found necessary for enhanced germination of species with stony seed coat such as *Tectona grandis*.

1504 Manonmani, V; Vanangamudi, K. 2003. **Studies on enhancing seed germination and seedling vigour in teak (*Tectona grandis*)**. Journal of Tropical Forest Science 15(1): 51-58.

Several seed treatments were tried to improve the germination of fresh teak drupes taken from Kallar, Tamil Nadu. It is recommended that acid scarified drupes be soaked in 1 percent KNO_3 to enhance the germination and seedling vigour.

1505 Mascarenhas, L.P. 1915. **Germination of teak seeds**. Indian Forester 41(5): p147.

Reports of an experiment at Kakankote, Mysore with the following types of teak seed: seeds soaked in cowdung, seed without any treatment and charred seed from burnt teak forest. Charred seed found profusely germinated within fifteen days.

1506 Masilamani, P. 1996. **Seed technological studies in teak (*Tectona grandis* Linn.f.)**. Ph.D Thesis. Tamil Nadu Agricultural University, Coimbatore, India.

1507 Masilamani, P; Annadurai, K. 2003. **Influence of seed treatment on germination and initial seedling vigour of irrigated teak (*Tectona grandis* Linn.f.)**. Indian Journal of Forestry 26(1): 48-52.

A study was conducted to find out the effect of pre-sowing treatments on the germination and seedling vigour of irrigated teak. The drupes, subjected to pre-sowing treatments were germinated under open condition. Soaking and drying of drupes for 5 days at an interval of 12 hours followed by soaking in 2 percent Potassium Nitrate solution recorded 45 percent germination against 21.3 percent in the control.

1508 Masilamani, P; Dharmalingam, C. 1998. **Effect of orientation of drupe placement and depth of sowing on germination and vigour of teak**. Advances in Plant Sciences 11(2): 205-209.

The drupes were treated by alternate soaking and drying for 6 days at 12-h intervals and then sown in sand in pots at 1.5, 3 and 5 cm depths with the scar end in inverted, upright and horizontal positions. Placing the drupes with the scar end up or horizontally at a depth of 1.5 to 3 cm resulted in early and higher germination, more seedlings/100 drupes, higher root and shoot length, and greater dry matter production and vigour.

1509 Masilamani, P; Dharmalingam, C. 1998. **Germination improvement in teak (*Tectona grandis* Linn.f.) through forced ageing**. Current Science 75(4): p356.

A study was conducted to test the applicability of the accelerated aging technique for improving the germination and seedling vigour of teak. Drupes aged for 13 days showed 53 percent germination which was 35 percent more than the non-aged control drupes. It was suggested that forced aging could be used for commercial seedling production within a minimum period of time.

1510 Masilamani, P; Dharmalingam, C. 1999. **Effect of seed treatment with hydrogen peroxide on germination and seedling vigour of teak (*Tectona grandis* Linn.f.)**. Tropical Agricultural Research and Extension 2(1): 26-29.

The effect of pre-sowing treatments on the germination and seedling vigour of nine month-old teak drupes was studied. The drupes, subjected to pre-sowing treatments were germinated under open and mist chamber conditions. Soaking and drying of drupes for 5 days at an interval of 12 hours followed by soaking in 1.5 percent hydrogen peroxide solution resulted in 47 percent and 52 percent germination under the open and mist chamber conditions compared with 29 percent and 15 percent respectively in the control.

1511 Masilamani, P; Dharmalingam, C. 1999. **Germination behaviour of teak (*Tectona grandis* Linn.f.) drupes in fly ash incorporated medium**. Advances in Plant Sciences 12(1): 57-61.

The germination of fresh and 1-yr-old teak drupes collected from a 60-yr-old seed production area in Tamil Nadu was tested in nursery growing media incorporating fly ash. Before sowing drupes were pretreated by alternate soaking and drying at 12-h intervals over 6 days. The older drupes germinated and produced more and better quality seedlings than the fresh drupes in all the media.

1512 Masilamani, P; Dharmalingam, C. 1999. **Influence of seed treatment with potassium nitrate on germination and seedling vigour of teak (*Tectona grandis* Linn.f.)**. Indian Journal of Forestry 22(1/2): 1-6.

Soaking and drying of drupes for 5 days at intervals of 12 h followed by soaking in 4.5 percent potassium nitrate solution and germinating in the mist chamber gave the maximum germination of 52.0 percent.

1513 Masilamani, P; Dharmalingam, C. 2001. **Effect of accelerated aging on germination and seedling vigour of teak (*Tectona grandis*)**. Journal of Tropical Forest Science 13(1): 93-98.

Ageing was carried out in an ageing chamber maintained at 100 percent RH and 40 degree C. The fruit stones aged for 13 days showed 53 percent germination against 18 percent in the control in normal open condition after 28 days of sowing. Fruit stones in mist chamber gave 39 percent germination against 14 percent in the control after 11 days ageing.

1514 Masilamani, P; Dharmalingam, C; Annadurai, K. 2002. **Effect of natural ageing on germination and seedling vigour of teak (*Tectona grandis* Linn.f.) drupes**. Indian Journal of Forestry 25(1/2): 122-126.

The fresh, one and two year old drupes were allowed for germination under open and mist chamber conditions following soaking and drying of drupes for 6 days at an interval of 12 hrs recorded 8, 37 and 51 percent and 3, 40 and 50 percent germination respectively. Seedlings from one and two year old drupes also exhibited better seedling vigour than fresh drupes.

1515 Masilamani, P; Singh, B.G; Manimuthu, L. 1998. **Influence of collection methods and treatments of seeds on the germination and seedling vigour of teak**. Bangladesh Journal of Forest Science 27(2): 138-140.

Crown collected drupes did not germinate without preconditioning and preconditioned drupes gave 2.75 percent germination. Ground collected drupes gave 7.5 percent germination without preconditioning and 32 percent germination with preconditioning.

Seedling emergence, time to emergence and seedling growth and vigour were improved in preconditioned ground collected drupes.

1516 Mathew, J; Vasudeva, R. 2003. **Clonal variation for seed germination in teak (*Tectona grandis* Linn.f.)**. Current Science 84(8): 1133-1136.

Reported a negative association between age of the mother tree from which the clonal material was derived and the per cent germination of its progeny.

1517 Mishra, M. 1991. **Effect of tree growth on emptiness in teak fruits**. Vaniki Sandesh 15(3): 4-6.

There was less emptiness in fruits from trees of higher girth classes of 121-200 cm gbh and seeds from fruits from trees of higher girth classes also gave better germination.

1518 Mishra, M; Pal, M. 1997. **Physiological assessment of germinability of teak seed**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 68-69. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

The silvi-climate of the zone of seed origin, age of the mother trees, nutrient status of the seed, and presence/absence of inhibitory substance, etc. exert a strong regulatory effect on germination of teak seed. Pre-soaking of seed in water, acid or alkali for varying duration of time, alternate soaking and drying, brief exposure to gamma radiations, scarification, treatment with growth regulatory substances, etc. have been shown to improve the germination.

1519 Mistry, S. 1998 . **Large-scale patterns of seed dispersal**. Forest biodiversity research, monitoring and modeling. Conceptual background and Old World case studies: 197-219. F. Dallmeier; J.A. Comiskey, Eds. Man and the Biosphere Series Volume 20. Parthenon Publishing Group, Carnforth, UK.

Three examples of natural disturbance in a coastal evergreen forest in southern India, human disturbance and dispersal modes in a deciduous teak forest in western India, and seed dispersal modes across latitudinal and moisture gradients were used to illustrate seed dispersal modes at large scales.

1520 Mohd Zaki Abdullah; Ab Ghani, A.R; Mohd Noor Mahat; Amir Saaiffudin Kassim. 2002. **Germination of *Tectona grandis* progenies during nursery stage**. Journal of Tropical Forest Science 14(4): 552-554.

The germination percentages ranged from 2 to 74 percent with an average of 34.8 percent. The 34 tested plus trees could be grouped into two groups in terms of their germination ability; 13 individuals were found to give more than 50 percent germination while another 11 individuals produced less than 20 percent germination.

1521 Montero, N.C; Estevez, M. J.E. 1983. **Response of seeds of 16 tree species to various pregermination treatments**. (Spanish). Instituto Nacional de los Recursos Naturales Renovables y del Ambiente, Colombia, Investigaciones Forestales 14: 26p.

1522 Moss, S.G. 1892. **The germination of teak**. Indian Forester 18: 178-181.

Two morphological structures of teak leaf are described and the problem of artificial germination of teak seed is discussed. After 48 hours of soaking, seeds are sown.

1523 Msanga, H.P. 1992. **Influence of seed size on germination and early development of teak (*Tectona grandis* Linn.f.) seedlings**. NTSP Research Note 1: 9p. National Tree Seed Project, Morogoro, Tanzania.

1524 Mutanal, S.M; Patil, S.J; Hosalli, R.B; Nadagoudar, B.S. 2003. **Effect of tree age and diameter on germination of teak**. Karnataka Journal of Agricultural Sciences 16(3): 481-484.

A study was conducted to determine the effect of age and diameter at breast height classes of teak trees on seed germination. Seed weight, seed diameter and germination were higher in seeds collected from 25 year old trees grown in agroforestry systems compared to trees of the same age grown in plantations.

1525 Muttiah, S. 1975. **Some data on teak seed and further pregermination treatment trials**. Sri Lanka Forester 12(1): 25-36.

Germination tests showed that germination percentage is highest 2-4 months after collection. Seed pretreatment experiments showed that a treatment of 48 hours in stagnant water followed by alternate soaking and drying on a 12-hour cycle for 4 days gave the best germination.

1526 Ngulube, M. 1986. **Preliminary study on germination of pretreated seed of teak (*Tectona grandis*) under nursery conditions in Zomba, Malawi**. Forest Ecology and Management 17(2/3): 147-151.

The 96-h stream-soaked pretreated seed demonstrated superior followed by seed pre-treated by container soaking for 96 h and alternate drying and wetting for one week.

1527 Ngulube, M. 1988. **Effect of seed pretreatment on the germination of teak (*Tectona grandis* Linn.f.) in the nursery**. Journal of Tropical Forestry 4(2): 143-146.

Different methods of treatment of seeds for germination are described like soaking and alternate drying and soaking and removal of exocarp. More than 50 percent germination got after 14 months.

1528 Nisbet, J. 1907. **The sowing or dibbling of teak in Burma**. Indian Forester 33(1): 12-17.

Referring to Mr. Troupe's article on failure of teak dibblings, reports earlier teak dibblings of 1876 in Bwet Range of Tharrawaddy Division and comments on highly successful dibblings later confirmed by inspection of 1896. He recommends removal of teak rather than taungya method or artificial planting.

1529 Norman, J.C. 1977. **Influence of pre-sowing treatments and seed age on germination of seeds of teak (*Tectona grandis*)**. Ghana Forestry Journal 3: 11-14.

1530 Oliver, J.W. 1907. **The sowing or dibbling of teak seed in Burma**. Indian Forester 32(5): 241-243.

Reports large scale sowings in the same reserve of 1881. He reports in bamboo flowered areas - an intense fire after death of bamboo, if seed trees are present will give rise to extensive reproduction of teak without aid of artificial sowings.

1531 Osmaston, L.S. 1908. **Treatment of teak seed for germination**. Indian Forester 34: p534.

The method consists of filling a pit with teak seeds and covering the same with a layer of earth 1" thick and thoroughly watering every third day for six weeks. Then the seed is taken out and spread in sun for three weeks and the seed is sown with commencement of rains.

1532 Pakdee, P. 1961. **Comparison of the germination of teak seeds of different sizes**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Compared the germination performance of five different size classes of seeds.

1533 Panjamanondh, W. 1962. **Comparison of the germination of teak seeds soaked in hot water of different temperatures**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Seed soaked in hot water of different temperatures for 5 minutes when sown gave different percentage of germination.

1534 Pearson, R.S. 1905. **Note on germination of teak and other seeds**. Indian Forester 31(3): 168-171.

Describes three methods of treatment. The method of putting seed in layers one inch think in a pit with alternate layers of earth of same thickness is found good.

1535 Pearson, R.S. 1905. **Note on the germination of teak and other seeds**. Indian Forester 31(11): 635-638.

Experience of the author in seed germination of various species under various conditions in the Central Nursery Division are briefly noted.

1536 Pelmer, R.W.V. 1935. **Treatment of teak seed before sowing in taungyas**. Indian Forester 61(8): 526-513.

Reports on Burma experiments on teak seed germination. The successful method consists of soaking the seed for 12 hours and then spreading it out to dry for 48 hours, the operation repeated several times and then the seed is sown.

1537 Perera, W.R.H. 1973. **Seed for Sri-Lanka's reforestation programme**. IUFRO International Symposium, Bergen, Norway on Seed Problems, 4-14 September, Vol. II: 13p.

A brief account is given of the situation, topography, climate zones and the natural forests of Sri Lanka. An extensive reforestation programme of 16,000 acres per year includes teak planting of 10,000 ac. Comments are also made on seed availability, quality, grading and certification to improve seed germination. Teak seed improvement programmes in Sri Lanka started by author in 1961 are also mentioned.

1538 Phothisaro, C; Thiamthong, S. 1978. **Observations on teak seed germination practice**. (Thai). Proceedings of the 1978 National Forestry Conference, Bangkok: 1-7. Ministry of Agriculture and Cooperatives, Bangkok.

1539 Piedrahita, E. 1979. **Study on storage and seed germination of *Tectona grandis***. (Spanish). First Seminar on forest seed, Colombia, 1979: 14.7-14.10. Primer Curso Sobre Semillas Forestales, Colombia.

1540 Pongpangan, S. 1966. **Study on the germination of teak fruits exposed to different duration and illumination of artificial light**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The experiment show that long duration exposure was better than short duration and intensity of light should be at suitable level, not too much nor too little.

1541 Pousugg, R.C. 1966. **Seed and nursery investigations-1966. Germination of teak seed and seedling development in the nursery**. Report of Thai-Danish Teak Improvement Centre 1967: 13p.

Germination tests of 1965, showed removal of exocarp by white ants increased germination percent. In a field test, the above treatment is found to be effective in producing higher number of nursery plants of uniform quality.

1542 Prasad, R; Jalil, P. 1986. **Emptiness in teak fruits from different areas of Madhya Pradesh**. Journal of Tropical Forestry 2(3): 207-212.

Fruits were collected from stands in Madhya Pradesh and from seed orchards in Dehra Dun, Nepanagar, Jabalpur and Seoni and emptiness and germination percentage recorded. There was no difference in emptiness among fruits of different origins although there was wide variation in germination. Germination was generally higher in seeds from comparatively moist areas.

1543 Punde, A.B. 1906. **Germination of teak**. Indian Forester 32(8): p409.

The method consists of cutting into the ground a bed of 3.5' x 2.5'x 6' deep and after removing all loose earth, bed filled with cowdung mixed with water. Put good healthy seeds and water every alternate day for a fortnight, and after a week majority will germinate.

1544 Rajput, A; Tiwari, K.P. 2001. **Effect of alternate chilling/heating on germination of fresh teak (*Tectona grandis* Linn.f.) drupes, without scarification of felty mesocarp**. Seed Science and Technology 29(1): 57-64.

This paper deals with the effect of alternate chilling and heating treatment on teak fruit to overcome mechanical dormancy due to hard stony endocarp. The endocarp is the main hindrance in seed germination. Quick change in temperature resulted in splitting of the endocarp and facilitated the emergence of the radicle.

1545 Ramana Rao, P.V. 1924. **Notes on the germination of teak seed in the course of one month**. Indian Forester 50(5): 259-260.

Reports Kurpum experiments, in which one or two day old cattle dung mixed with water to form a thick solution to which a small quantity of lime was added, in which teak seed was allowed to soak in the mixture; after 24 hours soaking, seed sown in beds prepared and solution sprinkled over them. Seed covered with thin layer of manure and allowed to germinate. After one month nearly 80 percent of seed germinated.

1546 Ramirez, C; Salazar, R. 2000. **A practical and effective system for the scarification of *Tectona grandis* Linn.f. seeds in Panama**. (Spanish). II Simposio sobre avances en la produccion de semillas forestales en America Latina: Memorias, Santo Domingo, Republica Dominicana, 18-22 de octubre 1999: 169-170. Centro Agronomico Tropical de Investigacion y Ensenanza (CATIE); Turrialba; Costa Rica .

A scarification machine is briefly described. The seed germination rate of this machine was approximately 95 percent, compared to 40 percent with a traditional method.

1547 Ratanakoses, S. 1967. **Storing of teak seed**. Report of Thai-Danish Teak Improvement Centre: 11p.

Experiments on storing of teak fruits for one year show open storing results in loss of germination ability almost 50 percent, storing in sealed containers reduces this loss of germination percent, sun drying prior to sealed storing retained germination capacity.

1548 Ratanakoses, S. 1968. **Experiments on germination of teak - in the faculty of forestry, Kasetsart University**. (Thai). Proceedings of the first Silvicultural Seminar, Royal Forest Department, Ministry of Agriculture, Bangkok R-118: 120-139.

Summaries of various papers on experiments under taken in the faculty are presented.

1549 Royal College of Forestry, Sweden. 1974. **International symposium on seed processing, Bergen, Norway, 1973. I. Seed processing**. 239p. Royal College of Forestry, Stockholm, Sweden.

Out of twenty two papers three papers are on new techniques and progress in processes of extraction of forest seeds, X-ray radiography of teak seed and collecting, processing and storing tree seed for research use.

1550 Royal College of Forestry, Sweden. 1974. **International symposium on seed processing, Bergen, Norway 1973. II. Seed problems of developing countries**. International Union of Forest Research Organisations, Working Party S2.01.06: Seed problems. Royal College of Forestry, Stockholm, Sweden.

Out of thirty one papers following papers are on forest tree seeds. Exotic forest tree seed in Rhodesia; seed problems in Thailand; germination test on teak seeds from fertilized and unfertilized mother trees; seeds from V-4 clone at Mae Moh teak seed orchard, Lampang, Thailand; Problems of forestal seeds in Bolivia and other Latin American countries; seed problems as they affect forestry practice in Ghana; production forestry and role of seed management: A report on India; some problems and developments in forest tree seed research; scope of research on problems of tree seed in Bangladesh; seeds for provenance tests and afforestation in South America; problems of teak seed; seed for Sri Lanka's reforestation programme; present status and some problems of forest tree seeds in Korea and forest seed in Cuba.

1551 Rujakom, S. 1962. **Germination of teak seeds in sand supplemented with calcium carbonate**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Control gave 10.25 percent germination and with 0.125 percent Calcium carbonate gave 10.25 percent; 0.25 percent concentration gave 6.5 percent; with 0.5 percent concentration 5.75 percent germination and with 1.0 percent concentration the germination is 7.0 percent.

1552 Saengdech, T. 1964. **Comparison of the germination of teak seeds after soaking in sulphuric acid and oven-heated of various temperatures and periods**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Treated seed with sulphuric acid at 2.5, 5.0 and 10 percent concentrations, at temperature 40, 60, 80 degree C for 12, 24 and 48 hours were tested. The 10 percent concentration gave poor germination and oven-heated upto various temperatures differed significantly and oven heating for 24 hours best and 12 hours poorest.

1553 Sahai, K; Tandon, S. 1993 . **Studies on flowering and seed quality of some trees of *Tectona grandis* Linn.f.** Indian Journal of Forestry 16(2): 127-131.

Detailed observations are reported on flowering and seed quality of three 20-yr-old trees of the National Botanical Research Institute at Lucknow, Uttar Pradesh.

1554 Saini, B.C; Misra, K.K; Singh, R.V. 1999. **Effect of pre-sowing seed treatment on germination of teak (*Tectona grandis* Linn.f.) seeds in sand beds**. Indian Journal of Forestry 22(3): 245-247.

Seeds collected from Uttar Pradesh were pre-treated with water before sowing. The seeds alternately soaked in fresh water and dried in air 3 times at 24-h intervals started germinating 14 days after sowing. Maximum germination percentage of 60.5 got in hot water treatment.

1555 Sakcharoen, S. 1968. **Study on the number of teak seedlings obtained from difference in media germination**. (Thai). Student Thesis. Kasetsart University, Bangkok.

No effect of germinating medium was found and more the seed sown more seedlings were obtained.

1556 Sarowart, Ch. 1964. **Study on the size of teak stumps obtained from seeds of various sizes**. (Thai). Student Thesis. Kasetsart University, Bangkok.

By sowing various sizes of seeds, no correlation was obtained between seed size and the size of stump, the height of seedlings and survival percentages.

1557 Satyendramohan, S. 1915. **Germination of teak**. Indian Forester 41(1): 24-25.

Reported an observation with regard to the germination of teak seed in the Manipur forests, Central India. Teak seed soaked in a mixture of goat's dung and water in a pit in this method.

1558 Savinthoru, S. 1963. **Comparison on the germination of teak fruit between soaking in different concentration of sulphuric acid**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Teak seeds soaked in sulphuric acid in 5 percent and 20 percent concentration give good germination but not different from control and 10 and 15 percent concentration.

1559 Sharma, J.K; Mohanan, C. 1980. **Spermoplane microflora of stored seeds of *Tectona grandis*, *Bombax ceiba* and *Eucalyptus* spp. in relation to germinability**. Proceedings of the IUFRO Symposium on Forest Seed Storage, Ontario, Canada, 23-27 September 1980: 107-125.

Stored seeds of species including teak were harboured by a rich spermoplane microflora. *Aspergillus* was the most predominant genus in all the tree species. *Actinomycetes* and eight other fungal genera are reported for the first time on seeds.

1560 Sharma, J.K; Mohanan, C. 1997. **Seed microflora of teak and its effect on seed germination and seedling growth**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 113-117. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

The investigation was aimed at studying the micro organisms associated with stored seeds of *Tectona grandis* and their probable role in affecting germinability and seedling growth. These microorganisms are reported not only affect the quality of seed by causing deterioration, decay, acidity, heating, mustiness and toxin production but also the loss of germinability.

1561 Shintorn, S. 1963. **Comparison of teak seed germination by soaking in various concentration of sulphuric acid**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Results of seed germination by soaking in various concentration of sulphuric acid are presented.

1562 Shirley, G.S. 1927. **Notching of germinating teak seeds**. Indian Forester 53(6): p373.

Reports the Burma method known as Tharrawady or UPO Haling's method, used since 1922 gave about 90 percent stocking. Reports use of method for sal and recently with *Taraktogenos hurzii* and *Hydrocarpus* sp. but long extended period of germination over one year limits the use of this method.

1563 Singh, B. 1956. **Teak seed treatment with bacterial action**. Proceedings of the 9th Silvicultural Conference, Dehra Dun 1956. Part 1: 84-85.

Review the various treatments applied in the past and describes a new procedure successfully tried in the drier conditions of Central India.

1564 Singh, T. 1932. **Notes on germination technique in the Central Province**. Indian Forester 58: 704-712.

Described the dona system of teak seed germination and its advantages and firing of the forest area to be naturally regenerated with teak.

1565 Sirikul, W. 1992. **Constraints to seed ontogeny and seed production in Thailand: An overview**. ASEAN Canada Forest Tree Seed Centre Project 14: 12p. ASEAN Canada Forest Tree Seed Centre, Saraburi, Thailand.

This paper reviews the factors associated with constraints to seed ontogeny and seed production in the four important tree species including teak in Thailand. Principal difficulties examined are juvenility, clonal variation and genotype X environment interactions.

1566 Sivakumar, V; Parthiban, K.T; Singh, B.G; Gnanambal, V.S; Anandalakshmi, R; Geetha, S. 2002. **Variability in drupe characters and their relationship on seed germination in teak (*Tectona grandis* Linn.f.)**. Silvae Genetica 51(5/6): 232-237.

Germination trials were conducted of the seeds collected from thirty sources covering India, Bangladesh and Laos. The mesocarp weight and drupe; shell weight ratio were negatively correlated with germination percentage. A polynomial regression for prediction of germination percentage using drupe; shell weight ratio was established. Germination percentage was correlated with the percentage of two seeded drupes.

1567 Sono, P. 1978. **Teak seed situation of Lampang Divisional Forest Office in 1978**. (Thai). Proceedings of the 1978 National Forestry Conference, Bangkok, 6 November 1978. Royal Forest Department, Ministry of Agriculture and Cooperatives, Bangkok.

1568 Srimathi, R.A; Emmanuel, C.J.S.K. 1986. **Improved teak seeds - management and eco-**

nomics. Journal of Tropical Forestry 2(4): 261-266.

Results are tabulated of a survey of planting targets and seed requirements for 24 species including teak by state in the central, north, south and east regions of India. Teak seed requirements by state, sowing rates and costs of collection are also given.

1569 Suangtho, V. 1980. **Factors controlling teak (*Tectona grandis* Linn.f.) seed germination and their importance to Thailand**. M.Sc Thesis. Australia National University.

1570 Suangtho, V. 1992. **Study on teak seed germination effects of long-term storage methods**. Proceedings of the Seminar on 50 Anniversary of Huay-Tak Teak plantation, Bangkok, 5-8 August 1992.

Five storage treatment procedures were applied included normal storage by keeping teak seeds in jute sacks and stored under shed, sealed container in cold room, aerated bags in cold room, sealed container in seed storage room and aerated bags in seed storage room. The results showed that storing of seeds in sealed container in cold room was the best method in keeping teak seed for a long period.

1571 Sukwong, S. 1963. **Study on the teak seed germination by alternate soaking in hot-water and oven-heated**. (Thai). Student Thesis. Kasetsart University, Bangkok.

After soaking in water for 48 hours, oven-heated for 35-40 degree C for 48 hours alternately for 8, 6, 4 and 2 times and control. Germination percent is 7.25, 10, 4.25, 1.25 and 5 percent respectively.

1572 Sumantakul, V; Yingransiri, T. 1979. **Long term teak seed storage**. (Thai). Report on silviculture 1977-1978. Ministry of Agriculture and Cooperatives, Bangkok. Royal Forest Department, Silviculture Division.

1573 Supidhyaporn, W. 1962. **A comparison of teak seed germination by different mechanical processes**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The experiment shows that naked seed gave 38.4 percent and results are significantly different from seed cut opposite radicle gave 26.6 percent germination, broken seed gave 25.6 percent and fruit gave 19.8 percent germination.

1574 Suresh, K.K; Jambulingam, R; Sekar, I. 1998. **Effect of fruit size and sowing density on quality and recovery of stumps in *Tectona grandis* (Linn. F.)**. International Tree Crops Journal 9(3): 195-202.

This study aimed at finding the effect of grading teak fruits on stump quality and optimal sowing density for different sizes of fruits. There was a positive and significant correlation between fruit size and the number of stumps. There was no correlation of fruit size with seedling size or of fruit size with stump size.

1575 Thaninpong, S. 1963. **Study on teak seed germination by soaking in oven-heated treatment and soaking in cold-water**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Oven heated seeds in hot water at 50 degree C for different periods and soaked in cold water gave the following results: 4 hours oven heated and cold water for 4 hours gave 30.5 percent, 3 hours oven heated and cold water for 4 hours gave 28.5 percent, 2 hours oven heated and cold water for 4 hours gave 34.5 percent, 1 hour oven heated and cold water gave 32 percent and control not oven and cold water for 4 hours gave 33.5 percent.

1576 Tiwari, C.K; Sharma, S; Verma, R.K. 2004. **Effect of fungicide and plant growth hormones on germination of teak (*Tectona grandis*)**. Journal of Tropical Forest Science 16(1): 25-34.

The effect of fungicide and plant growth hormones on germination of teak seed was studied in a four-factorial experiment. Under fungicide application maximum seed germination was recorded in NAA at 25 ppm, with three hours soaking followed by GA, at 15 ppm, 5 hours and IAA 5 ppm, 5 hours. Relative cost/benefit ration of hormone application and economics of seed treatment with fungicide and hormones showed that NAA and IAA, 5 ppm with fungicide were the best treatment.

1577 Totey, N.G; Shadangi, D.K; Khatri, P.K. 1994. **Allelopathic effects of van-tulsi (*Hyptis suaviolens*) on germination and growth of teak (*Tectona grandis*) seedlings**. Indian Journal of Forestry 17(2): 137-141.

Incorporation of *Hyptis suaviolens* into the soil in laboratory and nursery experiments inhibited the germination of teak and also inhibited the height growth of teak seedlings.

1578 Troup, R.S. 1905. **Teak dibblings why are they a failure?** Indian Forester 31(10): 565-568.

Failures are attributed to selection on sites not adequately exposed to heat of sun, too late sowings and non-preparation of ground by burning leaf litter, hoeing soil etc., before sowing and covering seed slightly.

1579 Troup, R.S. 1907. **The sowing or dibbling of teak seed in Burma**. Indian Forester 33(4): 183-185.

Author is of the opinion that the taungya system is the only one on which we can place reliance. Burmese teak plantations thinning programmes also discussed.

1580 Tuggerse, M.S. 1925. **Some methods for securing germination of teak-seed**. Indian Forester 51(4): 163-170.

Discussed on pretreatment of teak seed, handling of transplants and planting methods and recommends using of weathered seed and sowing *in situ*, use of one to two months old transplants and to use one year old plants.

1581 Tuggerse, M.S. 1925. **Some methods for securing germination of teak-seed**. Indian Forester 51(5): 230-231.

It is the part of an earlier report published in Indian Forester 51(4), 1925: 163-170 on germination of teak seed.

1582 Tuggerse, M.S. 1925. **Some methods for securing germination of teak-seed**. Indian Forester 51(10): 533-534.

Comments on pit method of treatment and opines seed will rot in heavy rainfall areas and recommends over ground treatment.

1583 Tuggerse, M.S. 1926. **Germination of teak seed**. Indian Forester 52(1): 32-33.

Weathering treatment of teak seed in sun and storage in gunny bags or bundles of dry hay are discussed.

1584 Tuggerse, M.S. 1928. **Viability of weathered teak seed**. Indian Forester 54(10): p543.

Teak seed weathered, kept packed in dry light paddy hay, when sown gave only 2.5 percent germination within one week and the author concludes that bulk of the teak seed after weathering does not retain its viability for more than one year.

1585 Unnikrishnan, K; Rajeev, K.P. 1990. **On germination of Indian teak (*Tectona grandis* Linn.f.)**. Indian Forester 116(12): 992-993.

Teak fruits collected from plantation in Kerala were cleaned and mesocarp was removed after soaking in water. Again treated by soaking in IAA or GA3 and control seeds were soaked in distilled water. All treatments increased germination over that of the control.

1586 Vasquez, W; Gonzalez, A. 1997 . **Calibration of a portable humidity measurement device, qwik-test for seeds of *Gmelina arborea* and *Tectona grandis***. Boletin Mejoramiento Genetico y Semillas Forestales 17: 19-24.

1587 Vasquez, W; Salazar, R. 2000. **Germination protocol for *Tectona grandis* Linn.f. in the laboratory**. (Spanish). II Simposio sobre avances en la produccion de semillas forestales en America Latina: Memorias, Santo Domingo, Republica Dominicana, 18-22 de octubre 1999: 159-162. Centro Agronomico Tropical de Investigacion y Ensenanza (CATIE); Turrialba; Costa Rica .

Teak seeds from Costa Rica were subjected to five treatments. The highest germination rate of 60 percent was obtained after scarification followed by 24 h in water at a temperature of 32°C without light.

1588 Vijaya, T; Srivasuki, K.P; Sastry, P.S. 1996. **Role of gibberellic acid in teak seed germination and the effect of *Glomus macrocarpus* on growth and sodic soil tolerance**. Annals of Forestry 4(2): 211-212.

The seeds were soaked in GA3 for 6 h at room temperature before testing germination. Sodic soil tolerance was studied using seedlings produced from the GA3 seed treatment. The seedlings were planted in pots and some of the pots had *Glomus macrocarpus* mixed into the soil. It is found that the mycorrhiza treated seedlings were more tolerant of the sodic soil, surviving better and exhibiting significantly greater growth and chlorophyll content than the controls.

1589 Viswanath, S; Surendran, T; Chacko, K.C; Chand Basha, S. 1996. **Effect of fruit grading, pre-sowing treatments and media on germination and growth of *Tectona grandis* Linn.f**. Journal of Tropical Forestry 11: 98-102.

Teak fruits collected from plantations in Kerala falling in moist teak zone were size graded and after presowing treatments sown in vermiculite and sand media. Analysis of results revealed that there was a distinct advantage in using large sized fruits. Pretreatment of seeds by soaking in GA3 100ppm solution for 12 hours yielded the best results out of the 4 pretreatments tested with respect to germination characteristics biometric and biomass observations.

1590 Wasuvanich, P. 1992. **Teak seed for reforestation programme**. Proceedings of the Seminar on 50 Anniversary of Huay-Tak Teak plantation, Bangkok, 5-8 August 1992.

1591 Wataniyakul, T. 1966. **Study on the germination percent of teak seeds at-11c for various periods**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The treatments include storage for 3, 6, 9 and 12 days. It was concluded storage has no effect on germination percent and height growth.

1592 Watcharakitti, S. 1962. **Comparison of the germination of teak seeds soaked in Sulphuric acid of different concentrations**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Five treatments - control 1, 20, 30 and 40 percent concentration used indicated that 10 and 20 percent gave best germination.

1593 Wijesinghe, L.C.A. 1963. **An investigation of the relation between the quantity of seed sown and the out-turn of stumps in teak nursery work**. Ceylon Forester (n.s.) 6(1/2): 31-36.

Taking into consideration both nursery space and cost of seed, it is concluded that out of the rates tested 12 lb. is found the best.

1594 Wijesinghe, L.C.A. 1963. **Pre-sowing treatment trials on teak**. Ceylon Forester (n.s.) 6(1/2): 4-11.

Experiments with different periods of soaking showed that best germination was obtained from seed soaked for 48 hrs.

1595 Wimbush, A. 1927. **Notching of germinating teak seeds**. Indian Forester 53(2): 86-88.

Describes a mount Stewart method wherein teak seed dumped in teak plantation area during South West monsoon and germinating seeds from dump were notched at stakes where regular sowings failed and 70 percent of saplings in successful teak plantations are attributed to this method. Pricking out 6"x6" germinating seeds in the nursery beds is also suggested.

1596 Wind, R. 1921. **Seed research in general and a few remarks and investigations on the flowering, fruit and germination of teak**. Tectona 14: 16-76; p116; 379-427.

1597 Wood, P.J. 1966. **Teak germination**. Tanzania Silvicultural Research Note 1967.

The author describes an experiment on germination with six treatments, results of which are reported in 1970, after further trials.

1598 Wood, P.J. 1970. **The germination of teak seed**. Silviculture Research Institute, Lushoto 13.

Germination experiments on freshly collected teak seed include broadcast sowing under shade, three days water soaking and broadcast in shade, broadcast in sunlight, sowing in sunlight, after three days soaking, eight months stored seed sown in sunlight, but shaded after germination and stored seed sowing in sunlight and shaded. Results confirm effectiveness of soaking teak seed for three days sowing in sunlight.

1599 Xuezhi, S; Wenming, L. 1991. **Studies on pretreatments and techniques for quick germination of teak fruits**. Forest Research, China 4(6): 616-622. Institute of Tropical Forestry, Chinese Academy of Forestry.

1600 Yadav, J.P. 1992. **Pre-treatment of teak seed to enhance germination**. Indian Forester 118(4): 260-264.

Teak seeds were collected from a plantation at Kailashahar, N. Tripura were given various soaking treatments and alternate soaking and drying at 24-h and 48-h intervals. The most rapid germination occurred in the alternate soaking and drying treatments but the highest total germination was in the soaking treatment of six days. All treatments except soaking for 10 and 12 days and the alternate soaking/drying treatments increased germination over that in the control.

1601 Yap, S.K; Wong, S.M. 1983. **Seed biology of *Acacia mangium*, *Albizia falcataria*, *Eucalyptus* spp., *Gmelina arborea*, *Maesopsis eminii*, *Pinus caribaea* and *Tectona grandis***. Malaysian Forester 46(1): 26-45.

Seed morphology, collection methods, extraction and storage and results of germination tests are described for seven species including teak.

1602 Yingransiri, T. 1979. **Seed characteristics among teak provenances**. (Thai). Proceedings of the Forestry Conference, 1979, Bang-

kok: 59-64. Ministry of Agriculture and Co-operatives, Bangkok.

1603 Yingransiri, T; Sumantakul, V. 1977. **Teak seed collection project**. (Thai). Proceedings of the National Forestry Conference, Bangkok, 16 December 1976: 588-598. Royal Forest Department, Ministry of Agriculture and Cooperatives, Bangkok.

Go top

Nursery Practices

1604 **Effect of diameter of teak stump used on survival percentage and early height growth**. Indian Forester 70(3), 1944: 79-80.

In an experiment carried out in the Bori forests, teak stumps over 0.5 inch diameter showed a 15 percentage higher survival and over 100 percentage greater height growth than stumps of smaller diameter.

1605 **The effect of longitudinal splitting of teak stumps**. Forest Research India and Burma 1946-47, 1950: p53.

Plants raised from halved teak stumps did not differ significantly in height growth from plants raised from whole stumps. Quartered stumps produced a significant loss of height growth. There is doubt whether these initial differences disappear with increasing age.

1606 **Size of teak stumps and comparison with dona (leaf-cup) plants and split stumps**. Forest Research, India and Burma 1948/49, Part 2, 1952: 23p.

Dona plants are found to have higher survival rate and better height growth at 1 year than stumps of 0.7 inch diameter and less. Height growth of stumps of 0.8 inch diameter was better than that of dona plants and survival 81 percent compared with 91 percent for dona plants.

1607 **Teak comparison of good and malformed stumps**. Forest Research in India Part II 1954-55, 1955: p74.

Malformed stumps are as effective as good stumps.

1608 **Teak: Splitting of teak stumps**. Forest Research in India Part II 1954-55, 1955: p74.

No difference was observed between entire and halved stumps in Madras state and hence in times of scarcity halved stumps can be used.

1609 Ani, J.R; Gopikumar, K. 1993. **Effect of potting media on growth and vigour of tree seedlings in the nursery**. Myforest 29(2): 121-124.

The effects of five growing media were tested on the growth of *Artocarpus hirsutus* and *Tectona grandis* in the Kerala University College of Forestry nursery. There were no significant differences between growing media for teak with regard to seedling height, diameter and number of leaves respectively.

1610 Apichart Kaosa ard. 1982. **Storage technique of teak (*Tectona grandis* Linn.f.) planting stumps**. Tropical forests: Source of energy through optimisation and diversification: 327-333. P.B.L. Srivastava, et al, Eds. Penerbit Universiti Pertanian Malaysia; Serdang; Malaya .

Stump plants of teak can be stored for over five months in an underground store filled with fine dry sand. Stumps lifted in Thailand during the dormant season and stored until the planting season survived and grew better than stumps that were conventionally lifted at the time of planting, especially under unfavorable planting conditions. Storage procedures and their research background are described.

1611 Apichart Kaosa ard. 1986. **Teak, *Tectona grandis*, Linn. F. nursery techniques with special reference to Thailand**. Danida Forest Seed Centre, Denmark, Seed leaflet 4A: 42p.

1612 Apichart Kaosa ard; Visetsiri, K. 1980. **Nursery techniques of teak. I. Effects of sowing depth on teak seed germination and seedling production**. (Thai). Vanasarn 38(1/4): 136-148.

Seeds were sown at depths of 0, 1.5, 3.0 and 4.5 cm and intervals of 1.5 cm in nursery beds. Both germination and seedling production were reduced with increasing depth.

1613 Basden, S.C. 1960. **Notes on deficiency symptoms in forest nurseries (*Tectona grandis*)**. Papua New Guinea Agricultural Journal 13(2): 76-77.

1614 Bhatnagar, H.P. 1966. **Effect of light on growth and uptake of nutrients in some forest tree seedlings**. Indian Forester 92(2): 79-84.

Determined the optimum light requirements of recently germinated seedlings of different species including *Tectona grandis*. Seedlings were subjected to varying amounts of shade for 1 1/2 years at Dehra Dun. Results of height and dry-weight measurements indicated that teak had grown most with approximately 94 percent daylight.

1615 Bryndum, K. 1966. **Seed and nursery investigations-1965**. Proceedings of the Seminar on Forest Seed and Tree Imperial, Thailand, 1966: 25p.

The various experiments in progress at Teak Improvement Centre are described with special reference to storing of teak seed, sowings in nurseries.

1616 Bryndum, K. 1971. **Teak nursery practice**. Vanasarn 29(1): 9-14.

Summarizes the results of research in 1965-69 at the Thai/Danish Teak Improvement Centre on the storage of teak seed and its grading, pre-sowing treatment and sowing rate in nurseries, on the lining out and watering of stock, and on the lifting and storing of stump plants.

1617 Champion, H.G. 1934. **Stump experiments in Java**. Indian Forester 60(3): 228-229.

The experience in Java and Dehra Dun of growing teak with stumps is reviewed.

1618 Chaudhari, N.R. 1963. **Preliminary trials of pre-sprouted stump planting for artificial regeneration of teak**. Indian Forester 89(9): 638-640.

This method will be a great promise for areas where there is a shortage of labour and the usual course of planting stumps at the onset of rains clashes with various agricultural operations.

1619 Dasappa. 1990. **Nursery techniques in teak (*Tectona grandis* Linn.f.) for afforestation**. Myforest 26(1): 23-31.

A brief account of nursery practices for teak in India is given which include information on distribution, provenances, silvicultural characters, seeds, transplanting and grafting, application of growth regulators and fertilizers and plant protection.

1620 Eidmann, F.E. 1933. **Cuttings and stumps**. (Dutch; English). Tectona 26: 618-679.

1621 Emmanuel, C.J.S.K; Bagchi, S. 1984. **Stock-scion compatibility in teak**. Silvae Genetica 33(2/3): 53-56.

Scions from plus trees from Kerala, Tamil Nadu, Andhra Pradesh, Orissa and Karnataka were grafted onto rootstocks of the Tunacadavu provenance from Tamil Nadu and kept in a mist chamber for the first 30 days and then under natural conditions for a further 30 days.

1622 Fernando, S.N.U. 1965. **Teak in Ceylon nurseries**. Ceylon Forester 7(1/2): 57-59.

A summary of nursery practice, with data on stocking from sampling of nursery beds and notes on storage of stump plants and pre-treatment of seed.

1623 Forest Department, Andhra Pradesh. 1935. **Draft prescriptions for teak nurseries for the guidance of working plan officers**. Forest Department, Andhra Pradesh, Ledger File 3.

Suggestions are offered on selection of site, type of nursery, preparation of the site, formation of beds, size of nursery, seed collection, quantity of seed to be sown, sowing method, seed treatment, tending of unthinned and thinned beds, shading the beds, outturn, costs, planting out stumps and method of planting stumps in the form of a departmental note for circulation.

1624 Forest Department, Coorg. 1939. **Treatment of teak stumps with Siradix-A**. Forest Department, Coorg, Annual Research Report 1939.

Field and nursery experiments were tried and results are furnished for survival and height growth. The treatment results in healthy initial development.

1625 Forest Department, West Bengal. 1959. **Nursery and garden works: *Tectona grandis***. Report of Forest Administration, West Bengal 1954/55: 31-32.

Experiments show that teak seed by soaking in pits give the maximum benefit at the end of 2 weeks after which further soaking had an adverse effect. Alternate soaking and drying for periods of 48 hours repeated approximately 6 times is also found effective.

1626 Griffith, A.L. 1936. **A brass gauge for use in making teak stumps**. Indian Forester 62(6): 350-351.

A brass gauge to measure the correct size of stumps of 0.4 to 0.6" was designed is described and illustrated.

1627 Griffith, A.L. 1942. **Stump production in Madras teak nurseries**. Indian Forest Records (n.s.) Silviculture 4: 225-257.

Experiments show that in order to get the highest production of stumps of the best size with the most economical use of seed, 1/8-1/5 lb. of seed should be sown per sq. ft. of nursery bed and no pricking out of seedlings done. And also reports that it is not desirable to use large central nurseries for teak because repeated cropping caused serious falling off in stump production in a few years and serious attacks by cock chafer and white ants occurred in 2 of the 5 years of the long-term nursery experiments.

1628 Griffith, A.L. 1943. **Stump production in Madras teak nurseries**. Indian Forester 69: 31-32.

1629 Gyimah, A; Siaw, D.E.K.A; Cobbina, J. 2001. **Manual for production of teak seedlings (*Tectona grandis*)**. Forestry Research Institute of Ghana. FORIG.

1630 Homfray, C.K. 1937. **Nursery and plantation notes for Bengal**. Bengal Government Press, Alipore: 203p.

1631 Hussain, A.M.M; Somasundaram, T.R; Subramanian, K.N. 1976. **A recent advance in teak culture**. Indian Forester 102(8): 531-532.

Buds from selected clones of *Tectona grandis* were grown successfully in polythene containers in a glasshouse, with artificial cooling and mist spray.

1632 Insawadhi, S. 1963. **Comparison of growth of teak stumps with single and double tap roots**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The survival of single tap root is better and growth of double tap root is better.

1633 Jackson, J.K. 1974. **Nursery techniques in the savanna region of Nigeria**. Federal Department of Forest Research, Nigeria, Research Paper Savanna Series 32: 8p.

Reviews nursery techniques use in the region and compares the merits of the planting stock raised from stump plants and plants raised in polypots.

1634 Kapoor, S.K. 1992. **Growth rate of teak seedlings in nursery**. Indian Forester 118(4): 303-304.

Details are given of nursery practices of bed preparation, seed source, time of sowing, germination, irrigation, weeding and hoeing, fertilizer application, insect attack and seedling condition.

1635 Khanal, B.K. 1975. **Nursery techniques for raising teak in Nepal**. Forests Department, Nepal, Technical Note 1-75: 4p.

Outlines techniques for the collection, storage and pre-treatment of teak seeds.

1636 Khedkar, M.H. 1999. **Advantages of raising teak (*Tectona grandis*) plantations by using root trainer plants**. Indian Forester 125(2): 133-136.

The performance of root trainer plants and stumps as planting stock of teak was compared. The growth of the root trainer plants was better and faster than that of the stump plants, but survival was similar. The root trainer plants have a shorter nursery period than stump plants).

1637 Khedkar, M.H; Subramanian, K. 1996. **Introduction of root trainer nursery technology in forestry sector - Maharashtra**. Indian Forester 122(3): 199-211.

A Nursery Development Unit has been created to introduce the root trainer nursery technology. Planting stocks of teak were raised in root trainers of 150 cm3 block type. Details of the efforts in introducing the root trainer nursery technology to raise the planting stock of different species including teak are described.

1638 Khedkar, M.H; Subramanian, K. 1997. **Trials on raising teak (*Tectona grandis*) planting stock in root trainers**. Indian Forester 123(2): 95-99.

This paper describes a trial to raise teak planting stock in block root trainers at two nurseries in Maharashtra. The teak seedlings raised in root trainers had given better lateral root development than the normal stump stock and produced multiple tap roots. The root trainer plants were found sturdier, healthier and had a larger collar girth than stump origin plants.

1639 Krishnankutty, C.N; Chacko, K.C. 2000. **A new criterion for estimating plantable stumps available in teak (*Tectona grandis* Linn.f.) nursery beds**. Journal of Tropical Forestry 16(4): 34-37.

For estimating the number of plantable stumps available in teak nursery beds in Kerala, a new plantability criterion based on seedling height as a proxy to stump thickness was identified.

1640 Kuerkool, P. 1985. **Nursery production techniques in Thailand**. Proceedings, Workshop on Nursery and Plantation Practices in the ASEAN, Jakarta, Indonesia, 3-7 October 1983: 36-42; 59-60. New Zealand Forest Service, Wellington, New Zealand.

Nursery practices followed by the Royal Forest Department servicing the reforestation programme in Thailand are described. An annual production of teak stumps of the department is 5 million.

1641 Kushalappa, K.A. 1980. **Permanent teak nurseries**. Myforest 16(3): 185-186.

The establishment of permanent teak nurseries in Karnataka and methods for accomplishing this outlined.

1642 Latif, M.A. 1982. **Distribution of the size of teak seedlings in the nurseries of Chittagong Forest Division**. Bano Biggyan Patrika 11(1/2): 24-27.

Data are presented from 5 nurseries on the total number of seedlings per bed, mean diameter 3 cm above the root collar, mean height, and numbers of seedlings with minimum root collar diameter of 1 or 1.2 cm. Estimates were made from measurements in sample strips in 50 beds per nursery using regression equations to calculate the number of seedlings for each root collar diameter limit. The best numbers were obtained from a nursery which used better seeds and a larger spacing. Further investigation on the optimum size of teak stumps for planting is recommended, since large variations in performance are presently found 5 months after planting.

1643 Latif, M.A; Islam, M.N; Choudhury, J.H. 1983. **Effect of stump diameter of teak on post planting survival and subsequent growth of height and diameter**. Bano Biggyan Patrika 12(1/2): 17-21.

Stump plants of diameter 1.01-2.00 cm are found producing the best height and diameter growth and the best survival in Bangladesh.

1644 Lauridsen, E.B. 1973. **Teak planting stock survives and grows well after storage**. TIC Experiment 75: 12p. Teak Improvement Centre, Ngao.

The study carried out to see if survival and growth after storage differs from unstored stumps. Storing of seedlings can be done in plastic containers and stumps in sawdust. Growth of stored plants was found better.

1645 Mathur, V.P. 1956. **Transplanting teak in containers**. Proceedings of the 8th silviculture Conference, Dehra Dun, 1951, Part 2: 250-252.

A detailed account of the technique of transplanting teak seedlings in leaf cups is given.

1646 Matin, M.A; Banik, R.L. 1993. **Effect of polybag size on growth of some forest tree seedlings of Bangladesh**. Bangladesh Journal of Forest Science 22(1/2): 37-43.

Seedlings of species including teak were raised in different sizes of polybags and growth performance studied in the nursery and in the field. The results showed that the height and diameter growth of the plants increased with the increasing size of polybag.

1647 Mbakwe, H.N. 1977. **Effect of asulam, dalapon and 2,4-D on the morphology of three months old teak seedlings**. Forest Series, Nigeria, Research Paper 37: 12p.

The herbicides asulam, dalapon and 2,4-D were sprayed on 3-month-old teak seedlings to assess their phytotoxicity. Asulam and dalapon caused damage to the seedlings. The younger leaves were not affected. Recovery was slower after application of dalapon and growth was retarded as a result of the loss of foliage. 2,4-D killed the seedlings.

1648 Mehrotra, M.D; Dadwal, V.S. 1978. **Study of the effect of gibberellic acid, urea and Rallis Tracel on the growth of teak in the nursery. I. Enhancement of growth of seedlings to transplantable size in the same growing season - a veritable possibility**. Indian Forester 104(10): 706-713.

Gibberellic acid applied as a foliar spray in nurseries increased the growth of teak seedlings, but they became lanky and chlorotic, with very small leaves. These adverse effects were reversed when the GA treatment was followed by weekly sprayings with urea + Rallis Tracel.

1649 Murugesh, M; Srinivasan, V.M; Rai, R.S.V; Annamalai, R. 1997. **Studies on curtailing nursery period in teak (*Tectona grandis*)**. Journal of Tropical Forest Science 10(1): 66-72.

A study was carried out at the Forest College and Research Institute, Tamil Nadu, on the optimal age of container seedlings and stumps of teak for best field performance under irrigated conditions. The optimal ages for container seedlings and stumps were found to be 3 and 7 months respectively.

1650 Na Lampoon, A. 1963. **Percentage of survival and growth of teak after storing the stumps for various periods**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Survival and growth of stumps after storing for 1, 2, 3, and 4 weeks were found out. It is found that growth of stumps after one and two weeks storage are better than control and three and four weeks storage.

1651 Neelay, V.R; Negi, K.S. 1983. **Effect of gibberellic acid and nutrients on the growth of teak in nursery. I - Poor performance of treated stumps in the field**. Indian Forester 109(3): 121-126.

Gibberellic acid, urea and Rallis tracel were applied as foliar sprays to seedlings growing in nursery beds in Madhya Pradesh. By the application of GA various phytotoxic effects such as chlorosis and reduction of leaf size were observed but these were alleviated by subsequent application of urea and Rallis tracel.

1652 Nwoboshi, L.C. 1976. **Size and physiological grades of some hardwood seedlings produced under different nursery spacings in Nigeria**. Forest Science 22(3): 301-306.

Teak seedlings planted at four spacings were graded after one year old according to their root-collar diameter. Teak seedlings of three root-collar diameter classes were planted out as stump plants. Survival and height growth at 6 months were found best with the smallest diameter stump plants which also showed more rapid root initiation and elongation in pot trials at 3 months after transplanting.

1653 Oever, H.Ten. 1908. **The setting out of stumps**. Tectona 1: 42-43.

1654 Ohene Coffie, F. 1999. **Cost of production of seedlings of forest tree species in a small-scale nursery**. Ghana Journal of Forestry 8: 37-42.

The cost of producing seedlings of different forest tree species including teak was determined in Ghana. Results of the study indicated that the unit cost of raising one potted seedling from a one-hectare nursery was C 139.40 for *Tectona grandis*.

1655 Rajkhowa, S. 1965. **Studies in mutual competition amongst forest seedlings. II**. Indian Forester 91(11): 767-777.

Discusses germination percentage and seedling survival of different species including teak at different seedbed spacings.

1656 Rao, P.S; Venkaiah, K; Murti, S.S.N; Sattar, S.A. 2001. **Root trainer vs. stump planting of teak -- a comparative study**. Indian Forester 127(11): 1289-1293.

An experiment was conducted to compare the performance based on survival, height and basal girth of root-trainer raised seedlings and stumps of teak at a research centre in Rajahmundry, Andhra Pradesh. Results showed that the root-trainer seedlings had obtained the highest height and girth at ground level and survival than the stumps.

1657 Reddy, C.V.K; Rao, A.L (et al). 1970. **A note on the nursery and plantation techniques**. Note of study tour in Maharashtra in Silvicultural Ledger file of Andhra Pradesh Forest Department 1971.

The large scale nursery and plantation techniques followed in Maharashtra are described from seed storage to stump pulling. It is recommended grading of teak seed, storage for one year, application of inorganic fertilizers and elimination of organic manures.

1658 Saju, P.U; Gopikumar, K; Asokan, P.K; Ani, J.R. 2000. **Effect of shade on seedling growth of *Grevillea robusta*, *Tectona grandis* and *Ailanthus triphysa* in the nursery**. Indian Forester 126(1): 57-61.

An investigation on the effect of shade on growth of polybag seedlings of species including *Tectona grandis* was carried out at College of Forestry, Vellanikkara, Kerala. Growth performance was better in full sunlight than in shade for *Tectona grandis* seedlings with height, diameter, leaf area, leaf size, root weight, shoot weight, leaf weight and chlorophyll content.

1659 Sardar, M.G; Subramanian, K. 1997. **Modern teak nursery management in Forest Development Corporation of Maharashtra Limited**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 38-42. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

The establishment of big central teak nursery by Forest Development Corporation of Maharashtra Ltd. has paved way for concentrated working, effective supervision, proper application of inputs such as fertilizer, and efficient management of pesticides. The cost per stump is found to be about 31 paise. The stump is currently sold at 50 to 62 paise. The current teak improvement works such as selection of seed production areas, plus trees, establishment of clonal seed orchards, tissue culture, etc. lead to genetical improvement of teak.

1660 Sharma, M.C; Bhandari, P.S; Mohmmad, G; Paroha, S; Chandra, K.K. 1997. **Effect of different soil mixtures on the production of quality seedlings of *Tectona grandis* in nursery**. Vaniki Sandesh 21(4): 3-7.

The effect of different soil mixtures was investigated on the development and quality of teak seedlings in the nursery at the State Forest Research Institute, Madhya Pradesh. Mixtures of soil/sand/farmyard manure in proportions of 1:1:1 gave good results for the loam soil with respect to shoot and root development and biomass production.

1661 Siddappa Kannur; Devar, K.V. 2003. **Influence of growing media on the seedling growth of teak**. Myforest 39(4): 323-327.

The paper presents the results of nursery experiment carried out at the silviculture nursery, Sirsi, Karnataka to determine suitable soil medium for production of quality plating stock from the teak stumps. Soil medium consisting of soil, sand and farm yard manure in a ratio of 1:1:2 found exhibited superior for growth and biomass attributes followed by medium consisting of equal proportions of soil, sand and farm yard manure.

1662 Singhal, R.M. 1949. **The dona technique of raising teak seedlings**. Indian Forester 75(11): 447-448.

Seedlings are transplanted when 8-10 days old into donas or leaf cups made from leaves of *Bassia latifolia, Butea frondosa* or *Diospyros tupru*. Each dona is approximately 5 inch in diameter and 7 inch deep and has a perforated bottom. Survival is better, especially during drought in the case of this technique.

1663 Siriwallop, K. 1966. **Effects of** gibberellic **acid at various levels on teak seedlings of various ages**. (Thai). Student Thesis. Kasetsart University, Bangkok.

It is observed that gibberellic acid spraying used with 3 week old seedlings effects both height and weight of seedlings but no effect on diameter.

1664 Somabutra, B. 1964. **Comparison of the growth of teak seedlings by using different concentrations of Gibberellic acid**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Out of five gibberellic acid treatments viz. 25,50,75,100 ppm and control, it was found that 100 and 50 ppm. is five times effective that of control and 75 and 25 ppm treatments are 4.0 and 2.9 times that of control.

1665 Subramanian, K; Gadbail, V.M; Rambabu, N; Jha, M. 1995. **Effects of culling on planting stock production in teak nursery**. Indian Forester 121(6): 465-468.

Culling experiments carried out at the Wada Nursery, Maharashtra, indicated that culling to remove seedlings showing poor growth, infection or infestation, or to reduce overcrowding, produces uniform and better quality planting stock.

1666 Sumantakul, V. 1971. **NPK fertilizers experiment in teak nursery**. Unpublished Report on TIC Experiment No. 54a.

Discussed the experiment on application of NPK fertilizer to teak nursery seedlings. It is indicated a positive reaction to fertilizer application.

1667 Tanukit, W. 1966. **Study on the effect of different covering media on teak seedling survival**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Sand covering gave the highest survival of 10.75 percent and height of 46.31 cm but smallest sized stumps of 0.77 cm. Rice shell covering gave the lowest survival but biggest stumps of 0-99 cm. It was suggested to use ash covering for moderate sized stumps and survival.

1668 TEAKNET. 1997. **Storage of teak stumps**. Teaknet Newsletter 6: 5-6.

A technique is described for storing teak stumps (planting stock) in sand in roofed over pits. Survival of stored stumps was better than that of fresh stumps. Height growth was reported better in stored than fresh stumps.

1669 Thanchai, P. 1965. **Effect of Gibberellic acid on the growth of one year old teak**. (Thai).

Student Thesis. Kasetsart University, Bangkok.

Treatment with 100, 75 and 50 ppm and control showed that 75 and 50 ppm treatments are not different from control, when one year height growth is considered.

1670 Totey, N.G; Bhowmik, A.K; Khatri, P.K; Chonhan, J.S; Kulkarni, R. 1986. **Growth of teak seedlings in nursery**. Indian Forester 112(9): 792-800.

Teak seeds were sown in a nursery at Jabalpur, Madhya Pradesh and treated with 150 or 300 kg/ha N, 75 or 150 kg/ha P and/or K or left untreated. Seedling growth in height and weight were measured.

1671 Tun, T. 2000. **Stored teak stump, simple technology but very reliable results can be achieved**. TEAKNET Newsletter 19: 5-6.

1672 Yadav, A.S; Khare, P.K; Mishra, G.P. 1982. **Growth performance of *Tectona grandis* Linn.f. seedlings in different pot culture media**. Indian Journal of Forestry 5(2): 86-89.

Seeds were wetted and dried alternately for 2 months before sowing in soil beds at Sagar Botanical Garden. After one month seedlings of equal height were transferred to 15 different media. Media were made by mixing black natural soil, sand and sawdust in different proportions. Seedlings were measured and found that growth was better in pure black soil than any other medium.

Go top

Vegetative Propagation and Tissue Culture

(See also 0510, 0660)

1673 **Progress report of the Forest Administration in Coorg for 1939-40**. Mysore Residency Press, Bangalore, 1941: 50p.

It is indicated that treatment with Seradix A promotes early root formation on teak stumps and the development of stumping.

1674 **Clonal forestry II: Conservation and application**. 240p. Springer Verlag, Berlin, 1993.

The underlying theory and recent results concerning the propagation and use of clones in research and in production forestry are discussed. A chapter on clonal forestry with tropical hardwoods which include the clonal forestry of *Tectona grandis* by Mascarenhas, A.F; Muralidharan, E.M is also included.

1675 Ansari, S.A; Ginwal, H.S; Kumar, P; Singh, S. 2001. **Ascorbic acid promotes adventitious rhizogenesis in teak (*Tectona grandis*)**. Indian Forester 127(5): 599-602.

A study was conducted to test the auxins of IAA, IBA and NAA and non-auxins of B-vitamins - thiamin and pyridoxine and C-vitamins - ascorbic acid and boric acid for adventitious rhizogenesis in leafy juvenile cuttings of teak.

1676 Ansari, S.A; Sharma, S; Pant, N.C; Mandal, A.K. 2002. **Synergism between IBA and thiamine for induction and growth of adventitious roots in *Tectona grandis***. Journal of Sustainable Forestry 15(4): 99-111.

Application of IBA and thiamine was investigated for induction and growth of adventitious roots in branch cuttings of teak. Administration of 1000 ppm IBA x 800 ppm thiamine is recommended for clonal propagation of teak on a large scale.

1677 Apavatjrut, P; Apichart Kaosa ard; Paratasilpin, T. 1988. **Current research on teak (*Tectona grandis* Linn.f.) tissue culture in Thailand**. Application of Tissue Culture Techniques economically important tropical trees. Biotrop Special Publication 35: 107-115.

1678 Apichart Kaosa ard. 1992. **Teak tissue culture**. Proceedings of the Seminar on 50 Anniversary of Huay-Tak Teak plantation, Bangkok, 5-8 August 1992.

1679 Apichart Kaosa ard; Apavatjrut, P. 1987. **Teak tissue culture**. Proceedings of His Majesty's 5th Cycle Commemorative Conference of USAID Science Research.

1680 Bahoenta, L; Sutjiati, L; Sumamburat, W. 1995. **Vegetative propagation of *Tectona grandis*: Culture technique**. Duta Rimba 20(181/182): 31-34.

1681 Bhatnagar, H.P. 1973. **Effect of hormone application on seasonal variation in rooting response of branch cuttings of forest trees**. Proceedings of Forestry Conference, 6-10 December 1973. Forest Research Institute, Dehra Dun.

1682 Bhatnagar, H.P; Joshi, D.N. 1978. **Rooting response of branch cuttings of teak (*Tectona grandis* Linn.f.)**. Indian Journal of Forestry 1(1): 79-83. [Proceedings of the Seventh World Forestry Congress, Centro Cultural General San Martin, Buenos Aires, Argentina, 4-18 October 1972, Vol. II, silviculture. 3. Trends and progress in new forest management and silvicultural techniques: 2045-2048].

Cuttings were taken from a 35-yr-old tree at Dehra Dun and dipped for 24 h in aqueous solutions of IAA, IBA or indolepropionic acid before setting in sand. Rooting and callus formation were recorded. All the hormone treatments are found promoted rooting and callus formation.

1683 Bhattacharya, A; Mandal, S. 1997. **Studies on in vivo pollen germination of some angiospermic plants**. Journal of Palynology 33(1/2): 153-156.

The paper deals with the in vivo germination of pollen grains of five angiospermic plants including *Tectona grandis*. Pollen germination was studied at different time intervals in the first day following anthesis. Highest *in vivo* pollen germination was recorded in *T. grandis*.

1684 Bingchao, K; Shuzhen, Z. 1991. **Standard of teak stump and its economic benefit**. Forest Research, China 4(6): 569-595. Institute, of Tropical Forestry, Chinese Academy of Forestry.

1685 Bon, M.C; Monteuuis, O. 1996. **Forest biotechnology in Sabah: Initial report**. Bois et Forests des Tropiques 248: 31-42.

An account is given of activities during the first two years of a joint project for forest biotechnology development and research, undertaken by CIRAD-Foret and Innoprise Corporation Sdn Bhd in Malaysia. Micropropagation techniques have been established for rattans and teak.

1686 Bonal, D; Monteuuis, O. 1997. **Ex vitro survival, rooting and initial development of in vitro rooted vs. unrooted microshoots from juvenile and mature *Tectona grandis* genotypes**. Silvae Genetica 46(5): 301-306.

The influence of in vitro formed adventitious roots on acclimatization and initial ex vitro development of microshoots from juvenile and mature teak genotypes was investigated. The in vitro rooted microshoots gave rise to higher survival.

1687 Britwum, S.P.K. 1970. **Vegetative propagation of some tropical forest trees**. Forest Product Research Institute, Technical Newsletter 4(1): 10-15.

1688 Bryndum, K. 1969. **Budding of teak**. Indian Forester 95(3): 155-157.

Describes the techniques followed at the Teak Improvement Centre, N. Thailand. Budding in November-December gives good results. Results are compared with those in India.

1689 Cao, Y.H; Wang, B.S. 1981. **Study on induction of rooting and survival of transplanted *Tectona grandis* Linn.f. in vitro**. Acta Botanica Sinica 23(6): 434-440.

The study reports on induction of rooting and survival rate of transplantation, after leafy shoots have been obtained in vitro. Out of three kinds of auxin ie. IAA, IBA, NAA were used for root induction, IBA was found the best.

1690 Chadhar, S.K; Sharma, M.C; Patley, R.K. 1998. **Suitable age of seedlings for preparing root shoots**. Vaniki Sandesh 22(1): 2-4.

Root-shoot cuttings were prepared from nursery seedlings of four species which include *Tectona grandis* in Madhya Pradesh. Seventeen month old seedlings gave the best results in terms of survival. Shoot growth was best in 13-month-old seedlings for *T. grandis*.

1691 Chamnankit, S. 1986. **Rooting variable of teak clone**. Research Report of Silviculture in 1984-1985, Royal Forestry Department, Bangkok 2: 381-389.

1692 Chia, F.R. 2003. **Field performance of tissue culture derived teak (*Tectona grandis*)**. Journal of Tropical Forest Science 15(3): 493-496.

This paper discusses the performance and characteristics of teak, clonally propagated through tissue culture in the nursery. Parameters measured were height, diameter at breast height, number of branches produced and number of trees producing flowers.

1693 Dabral, S.L. 1977. **Propagation of teak by root grafts**. Indian Forester 103(3): 225-230.

A new technique is described for propagating clones of *Tectona grandis*, which is difficult to root. Grafting a root from a seedling 1-2 years old on to the flowering branch of a plus tree or grafted clone was shown to yield over 90 percent success.

1694 Dabral, S.N; Ghei, V.N. 1961. **Some further trials with gibberellic acid**. Indian Forester 87(10): 583-589.

Observations are made on seedlings treated with gibberellic acid after transplanting. The effects of gibberellic acid did not persist after the treatment has stopped, height growth slowed down and morphological differences disappeared, but poor root development continued.

1695 Daquinta, M; Ramos, L; Capote, I; Lezcano, Y; Rodriguez, R; Trina, D; Escalona, M. 2001. **Micropropagation of teak (*Tectona grandis* Linn.f.)**. (Spanish). Revista Forestal Centroamericana 35: 25-28.

Epicormic shoots from teak trees in a forest nursery in Cuba, planted in pots in zeolite under cover and irrigated with a micro-jet. The buds of the epicormic shoots were treated with the rooting hormones IBA and NAA. Shoots from juvenile plants grown from seed were treated in the same way. Further testing was done in vitro.

1696 Daquinta, M; Ramos, L; Capote, I; Lezcano, Y; Rodriguez, R; Escalona, M. 2002. **Calli induction and plant regeneration in *Tectona grandis* Linn.f.** Biotecnologia Vegetal 2(1): 15-19.

A study was conducted to investigate the calluses induction and plant regeneration by shoot tips, immature flowers of mature tree explants and cotyledons from seed of *Tectona grandis*.

1697 Daquinta, M; Ramos, L; Capote, I; Lezcano, Y; Rodriguez, R; Escalona, M. 2002. **Morphogenesis *in vitro* of teak (*Tectona grandis* Linn.f.)**. (Spanish). Investigacion Agraria, Sistemas y Recursos Forestales 11(1): 137-144.

1698 Daquinta, M; Ramos, L; Lezcano, Y; Rodriguez, R; Escalona, M. 2000. **Some elements in the micropropagation of teak**. (Spanish). Biotecnologia Vegetal 1: 39-44.

A methodology of producing propagules from young and mature explants of *Tectona grandis* via in vitro propagation is presented. Different cytokinins were tested for shoot proliferation and auxins for ex vitro rooting and a procedure was developed to micropropagate elite mature trees.

1699 Darmono, R. 1987. **The technique of storing teak stumps in Ngao, Lampang**. (Indonesian). Duta Rimba 13(89/90): 22-28.

The production, storage and use of teak stumps is described and discussed with particular reference to studies on teak propagation in Thailand, and the potential use of the method in Indonesia.

1700 Date, G.P; Jalil, P. 1985. **Effect of gibberellic acid, Rallis Tracel-1 and urea on the growth of teak seedlings**. Journal of Tropical Forestry 1(4): 341-349.

Two months old seedlings were treated with 200 or 300 p.p.m. gibberellic acid, 0.1 percent Rallis Tracel containing Zn, Fe, Mn, Mo, B, Mg and S and 0.25 percent urea. Treated plants are found to have longer shoots, but these were lanky with larger internodes and chlorotic leaves.

1701 Devi, Y.S; Mukherjee, B.B; Gupta, S. 1994. **Rapid cloning of elite teak (*Tectona grandis* Linn.f.) by in vitro multiple shoot production**. Indian Journal of Experimental Biology 32(9): 668-671.

Shoot buds of different sizes were collected from an elite tree of West Bengal and the buds were cultured in agar gelled medium for three successive passages to allow brown exudates to leach out. Buds were transferred to an establishment medium containing MS salts + 1 mg/litre kinetin and 1 mg/litre benzyladenine along with adenine sulfate. Apical shoots 5-9 mm long collected in December were best for establishing cultures.

1702 Dharncaai, P. 1965. **Effect of gibberellic acid on the growth of one year old teak**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Teak seed treated with gibberellic acid of 100 p.p.m. increased height growth.

1703 Fernandez, E.E. 1876. **On production of shoots by teak trees in Central Province: A question of root-suckers production**. Proceedings of Forestry Conference, Simla. Forest Research Institute, Dehra Dun.

1704 Forest Department, Andhra Pradesh. 1935. **Grafting of teak: A short note**. Forest Department, Andhra Pradesh and Madras Ledger File 4.

It is shown that cleft grafting and bud or eye grafting both suitable for teak.

1705 Gangopadhyay, G; Gangopadhyay, S.B; Poddar, R; Gupta, S; Mukherjee, K.K. 2003. **Micropropagation of *Tectona grandis*: Assessment of genetic fidelity**. Biologia Plantarum 46(3): 459-461.

Random amplified polymorphic DNA markers were used to analyze genetic fidelity of micropropagated teak clones with respect to subcultural passage. Of the twenty primers screened, no variation in RAPD profiles was noticed in the in vitro clones of fifth, tenth, fifteenth and twentieth passage in comparison to the in vivo mother plants.

1706 Gavinlertvatana, P. 1995. **Commercial micropropagation of teak in Thailand. Teak for the future**. Proceedings of the 2nd Regional Seminar on Teak, Yangon, Myanmar, 29 May-3 June 1995.

1707 Goh, D.K.S; Galiana, A. 2000. **Vegetative propagation of teak**. Proceedings of the Seminar on High Value Timber Species for Plantation Establishment - Teak and Mahoganies, Sabah, 1-2 December 1998. JIRCAS Working Report 16: 35-44. H.H. Chan; K. Matsumoto, Eds.

A summary of experience gained in developing vegetative propagation techniques for teak by ICSB (Innoprise Corporation Sdn. Bhd) and CIRAD-Foret in Sabah, Malaysia is presented. Protocols are outlined for tissue culture from micro-shoots and ex vitro acclimatization.

1708 Goh, D; Monteuuis, O. 2001. **Production of tissue cultured teak: The plant biotechnology laboratory experience**. Potential and Opportunities in Marketing and Trade of Plantation Teak, Challenge for the New Millenium. Proceedings of the 3rd Regional Seminar on Teak, Yogyakarta, Indonesia, 31 July-4 August 2000: 237-247.

1709 Goswami, H; Keng, C.L; Teo, C.K.H. 1999. **In vitro shoot multiplication of *Tectona grandis***. Journal of Bioscience 10(1): 47-54.

1710 Gupta, P.K; Nadgir, A.L; Mascarenhas, A.F; Jagannathan, V. 1980. **Tissue culture of forest trees: Clonal multiplication of *Tectona grandis* Linn.f. (teak) by tissue culture**. Plant Science Letters 17(3): 259-268.

Plantlets were obtained from shoots excised from seedling explants and terminal buds of 100-year-old trees with high-quality wood on a medium containing 6-benzylamine purine and kinetin.

1711 Haines, R.J; Martin, B.E. 1995. **Biotechnology and the sustainable production of tropical timber**. ITTO Pre Project Report PPR 42/97 (F): p168.

1712 Hardjono, D; Leokito, D. 1959. **Budding experiment on teak**. Communication of Forest Research Institute, Bogor 68: 29p.

The budding method is described and illustrated. Success was related to the age of the mother tree from which scions were taken with mean figures of 70 percent successful buddings from those 20-50 years old.

1713 Hedegart, T. 1967. **Budding technique**. Progress Report of Thai-Danish Teak Improvement Centre, Nago, Thailand 1966: 1-8.

Budding experiments in progress were described and the double flap method developed was illustrated.

1714 Hedegart, T. 1968. **Budded stumps**. Teak Improvement Centre, Ngao, Lampang: 5p.

The results of the various budding experiments and the percentage of the success of each method is reported. Pre-sprouting of budded stumps and storing in fresh sawdust seems to contribute to greater percentage of success.

1715 Hedegart, T. 1968. **Investigation on propagation of teak by cuttings-1967**. Paper of Teak Improvement Centre, Nago, Lampang: 6p.

The investigations undertaken to examine the possibility of propagating teak by cuttings and to test the influence of two rooting hormones, auxins for root formation indicates, sealing cut end with wax on top helps rooting.

1716 Hedegart, T; Wangtara, N; Yingransiri, T. 1974. **Budded/potted teak stock**. Vanasarn 32(4): 337-341.

The traditional method of establishing clone collections and clonal seed orchards of *Tectona grandis* in Thailand is by budding stump plants in the field. A technique for raising stock by budding one-year-old stump plants grown in pots in a greenhouse is described and illustrated.

1717 Husen, A; Pal, M. 2000. **Analytical studies on the effects of interaction with respect to position, season and auxin on adventitious root formation in stem cuttings of mature**

teak (*Tectona grandis* Linn.f.). Annals of Forestry 8(2): 253-261.

The effect of canopy position of branch, season and treatment with NAA on the rooting of shoot cuttings of trees growing in Dehra Dun, Uttar Pradesh is studied. Treatment with NAA promoted the percentage of callusing, rooting, sprouting, number of shoots and roots per cutting and root length.

1718 Husen, A; Pal, M. 2001. **Interactive effect of auxin and etiolation on adventitious root formation in cuttings of *Tectona grandis* Linn.f.** Indian Forester 127(5): 526-532.

The effects of stock plant etiolation and auxin on rooting behaviour of stem cuttings taken from one-year old seedling of teak were investigated. It was observed that except mean shoot diameter, etiolation significantly increased mean shoot length, internodal length, number of coppice shoot, leaves and nodes, and the total soluble sugar content of the shoots.

1719 Husen, A; Pal, M. 2003. **Effect of serial bud grafting and etiolation on rejuvenation and rooting cuttings of mature trees of *Tectona grandis* Linn.f.** Silvae Genetica 52(2): 84-88.

An experiment was conducted to study the effect of serial bud grafting and etiolation on rooting stem cuttings. Auxiliary buds taken from two clones of mature teak trees and grafted on root stocks of two year old seedlings and again serially grafted on two year old root stocks. Clones of the first graft exhibited stronger rejuvenation as indicated by more profuse rooting of the cuttings after second serial grafting.

1720 Husen, A; Pal, M. 2003. **Clonal propagation of teak (*Tectona grandis* Linn.f.): Effect of IBA application and adventitious root regeneration on vertically split cuttings**. Silvae Genetica 52(3/4): 173-175.

Rooting behaviour of vertically split mono-nodal softwood cuttings of teak treated with indole-3-butyric acid is studied and found that these cuttings can be successfully used to mass multiply the clonal planting stock more rapidly.

1721 Jadjuabsin, S. 1967. **Storing of bud wood-1966**. Report of Thai-Danish Teak Improvement Centre, Ngao: 6p.

Reports the experiments on storing bud wood from two trees below freezing point, low temperature of approximately 10 degree C and in moist sawdust at room temperature. Moist sawdust is practicable upto 7 days storage.

1722 Jadjuabsin, S; Hedegart, T. 1968. **Storing of bud wood-1967**. Progress Report of Thai-Danish: 7p. Teak Improvement Centre, Ngao.

Experiments confirm the last year's work that storage in moist sawdust is good for a long period.

1723 John, C.K; Nadgauda, R.S; Mascarenhas, A.F. 1997. **Teak**. Tissue Culture of Economic Plants including Genetic Engineering Techniques: 110-128. Centre for Science and Technology of the Non-Aligned and other Developing Countries, New Delhi and Commonwealth Science Council, London.

Details of the micropropagation techniques followed for teak are discussed. Its distribution, biology, provenances, diseases and insect pests, economic importance, propagation, etc are. also discussed.

1724 Kadambi, K; Dabral, S.N. 1954. **Air layering in forestry practice**. Indian Forester 80(11): 721-724.

Forty two tree species including teak were tried for vegetative propagation by air layering method only eight species are successful. The details of the method as practiced at New Forest is given.

1725 Katwal, R.P.S; Singhal, R.M; Gurumurthi, K. 2001. **Quality propagule production and tissue culture of trees - discussion note**. Brainstorming session for Future Strategies for Tree Tissue Culture, Department of Biotechnology, India, 27 August, 2001.

1726 Kedharnath, S; Venkatesh, C.S. 1963. **Grafting as an aid in the breeding of teak (*Tectona grandis* Linn.f.) and semal (*Salmalia malabarica*)**. Proceedings of the FAO World Consultation on Forest Genetics and Tree Improvement, Stockholm FAO/FORGEN 63/-5/6: 2p.

Both top grafting and forkert type budding have been tried and found feasible in teak. Heteroplastic and reciprocal top grafting of stems of teak is found successful.

1727 Keiding, H. 1960. **Budding and grafting of teak (*Tectona grandis*)**. FAO Teak Sub-Commission, New Delhi, 1960, FAO/TSC-60/3.3: 6p.

Describes successful experiments in bud-grafting of teak by the `forkert' method

commonly used on *Hevea brasiliensis*. Bark patches containing a bud are grafted on to the exposed cambium of 2 + 0 stock in leaf. The method is promising for the establishment of seed orchards from good phenotypes.

1728 Keiding, H. 1961. **Budding and grafting of teak (*Tectona grandis* Linn.f.)**. Natural History Bulletin of the Siam Society 20: 27-39.

1729 Keiding, H; Boonkird, S. 1960. **Vegetative propagation of teak**. Unasylva 14(4): 193-194.

Describes successful experiments in budding teak by a method extensively employed on *Hevea brasiliensis*. Approximately 200 successful bud-grafts were made.

1730 Kendurkar, S.V; Dhage, A.B; Kulkarni, V.M; Jana, M.M; Mascarenhas, A.F. 1997. **Teak propagation**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 165-167. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

A modified MS basal medium containing low levels of hormones was found effective for all stages of tissue culture process of teak. Proliferation of axillary bud break without an intervening callus stage of adventitious shoot formation was achieved. Field evaluation of tissue culture raised plants revealed good growth and occurrence of flowering and production of viable seeds within three and half years.

1731 Kendurkar, S.V; Nadgauda, R.S; Sara von Arnold. 1999. **Studies on cryopreservation of teak (*Tectona grandis*): A tropical hardwood tree**. International Tree Biotechnology Meeting, NCL, Pune, 17-19 November 1999.

1732 Khaosaat, A; Aphawatcharut, P; Sombun, K. 1986. **Study and analysis of research on teak tissue culture**. Research Report of Silviculture in 1984-1985, Royal Forestry Department, Bangkok No. 2: 558-590.

1733 Khatri, J.H; Kukadia, M.U; Singh, R.R. 2001. **Micropropagation of teak (*Tectona grandis* Linn.f.)**. Indian Journal of Forestry 24(3): 368-371.

Laboratory experiments were conducted to explore the possibilities of micropropagating teak under controlled environment. To study the morphogenic response of teak explants in culture, Murashige and Skoog's medium and Woody Plant Medium were used.

1734 Kushalkar, R; Sharon, M. 1996. **Direct and indirect somatic embryogenesis in teak (*Tectona grandis* Linn.f.)**. Current Science 71(9): 712-715.

Apical and axillary buds from three-yr-old *Tectona grandis* were used to initiate the in vitro cultures. Callus from apical buds formed globular and heart-shaped somatic embryos on Murashige and Skoog medium.

1735 Lahiri, A.K. 1974. **Preliminary study on rooting of green wood cutting of teak**. Indian Forester 100(9): 559-560.

A note on trials in West Bengal in which vigorous terminal shoots of approximately 30 cm long and 4 cm in diameter were selected as cuttings from 15-year-old *Tectona grandis* trees. One hundred cuttings were planted horizontally in the soil, 20 percent of these sprouted and after 180 days were examined for root formation.

1736 Lahiri, A.K. 1985. **A note on possibilities of mound layering of teak**. Indian Forester 111(10): 870-871.

Stumps with coppice shoots were covered with soil after ringing the base of each shoot. The mounds were irrigated and all shoots had rooted, producing 15.6 percent roots/shoot on average.

1737 Lin, D.D. 1989. **The storage technique for small stick shoots of teak**. (Japanese). Tropical Forestry 16: 45-53.

Storage of bundles of small shoots of teak in tanks of sand is described. Preparation of the storage material is described including irrigation, fertilizer application and harvesting.

1738 Macalpine, R.I. 1935. **Teak seedlings versus root and shoot cuttings**. Indian Forester 61(12): 777-780.

Experience and method as applied to teak is reported from Kaptai, Chittagong Hills tracts in Bengal. The problems of transplanting and season are discussed and silvicultural experiments on root and shoot cuttings are reported.

1739 Mahapatra, P. 1970. **Experiment of grafting on teak in Orissa**. Proceedings of Seminar-cum-Workshop on Genetic Improvement of Forest Tree Seeds in India, Forest Research Institute, Dehra Dun: 80-82.

Reports the selection programme and breeding of teak undertaken in Orissa state, where 16 plus trees selected are included in a germplasm bank. Reports the results of grafting work done. The cleft grafting of teak followed in Orissa is considered a success taken in the state, for the supply of genetically improved seed for large scale future plantations.

1740 Mahtolia, D.C; Pal, M. 1995. **Effect of leaf retention and auxin treatment on rooting response of teak (*Tectona grandis* Linn.f.) cuttings**. Annals of Forestry 3(2): 188-192.

A study was taken up to find out the effects of leaf retention and IBA application on the rooting response of teak. Percentage rooting, number of roots produced per cutting, average root length and the dispersion of roots from the base of cuttings were significantly enhanced in the leafy cuttings by IBA application.

1741 Marsden, E. 1916. **Reproduction of teak by root suckers**. Indian Forester 42(2): 43-50.

Instances of reproduction of teak by root suckers are described and illustrated. It is reported as a method of reproduction of teak in Wyanad. The nature and characteristics of occurrence of root suckers is described and considers them as stool shoots.

1742 Mascarenhas, A.F; Kendurkar, S.V; Khuspe, S.S. 1991. **Micropropagation of teak**. Micropropagation of Woody Plants: 247-262. M.R. Ahuja, Ed. Kluwer Academic Publishers, Netherlands.

1743 Mascarenhas, A.F; Khuspe, S.S; Nadgauda, R.S; Gupta, P.K; Khan, B.M. 1988. **Potential of cell culture in plantation forestry programs**. Genetic manipulation of woody plants: 391-412. Basic Life Sciences 44. B.M. Khan; J.W. Hanover; D.E. Keathley, Eds. Plenum Press, New York, USA.

Results are summarized of field evaluations in India of plantlets produced by tissue culture of material from mature trees of species including *Tectona grandis*. Economic and other benefits of these procedures are discussed. Teak parents were comparatively selected on height, absence of side branches and good wood quality.

1744 Mathur, V.P. 1926. **Teak reproduction through cuttings**. Indian Forester 52(1): p33.

Early June cuttings sprouted in 15 days. Cuttings of 2nd week of August did not sprout at all. The high percentage of failures is attributed to late propagation, as teak in the locality flushed by mid-May.

1745 Meniaud, J. 1930. **Propagation of teak in tropical Africa**. Proceedings of the 5th International Tropical Agricultural Conference: p1002.

It is reported that the plantations of teak in the colonies on the Gulf of Guinea are as feasible as those in Indo-China, provided the trees are planted on the most favourable site. In Togoland and the Cameroons, teak grows as rapidly as the most vigorous native trees which produce wood of comparable density.

1746 Meniaud, J. 1930. **Teak and its propagation in Tropical Africa**. Extract des state et comptes Reirdus de e' Association Colonies-Sciences 62/63: 14p.

Planting of teak on favourable sites in the colonies of Gulf of Guianea are feasible as those of Indo-China. In Togoland and Cameroons, teak grows as rapidly as most of the native species and produces wood of comparable density and industrial value.

1747 Mishra, K; Mishra, G.P. 1984. **Effect of gibberellic acid on *Tectona grandis* and *Dendrocalamus strictus* seedlings**. Journal of Tree Sciences 3(1/2): 20-26.

One-month-old seedlings were sprayed once with concentrations of gibberellic acid ranging from 0.1 to 100 p.p.m. Shoot and root lengths and dry weight were recorded from 2 to 36 month old. All the lower doses of GA3 promoted seedling growth compared with control plants, the optimum dose is found 10 p.p.m. for *T. grandis*.

1748 Mishra, K; Mishra, G.P. 1986. **Effect of indole acetic acid on growth and dry matter production of *Dendrocalamus strictus* Nees and *Tectona grandis* Linn.f. seedlings**. Journal of Tree Sciences 5(2): 118-121.

The application of IAA to 1-month-old seedlings increased the growth and dry weight of shoots and roots but the use of higher concentrations suppressed growth.

1749 Mishra, M; Pal, M. 1997. **Aspects in vegetative propagation of teak**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 168-170. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Various methods of vegetative propagation of teak which can be used for raising clonal seed orchard, clonal banks and clonal plantation are reviewed. Grafting and budding are generally used for raising seed orchards and clonal bank plantations. Rooting branch cuttings of juvenile and adult tree has the potential for mass multiplication of clonal material rapidly for raising seed orchards and clonal plantations.

1750 Monteuuis, O. 1995. **Recent advances in mass clonal propagation of teak**. Proceedings of the International Workshop of Bio-Refor, Kangar, Malaysia, 28 November-1 December 1994. W. Ratman; Z.Y. Ahmad; H.M.S. Amir; H.A. Darus; K.C. Khoo; K. Suzuki; S. Sakurai; K. Ishii, Eds. Bio-Refor Tokyo; FRIM, Kuala Lumpur.

1751 Monteuuis, O. 2000. **Propagating teak by cuttings and microcuttings**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 209-222. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

A review of the vegetative propagation of rooted cuttings produced from stock plants in the nursery and in-vitro issued microcuttings. Discussed the establishment of clonal seed orchards and advantages and disadvantages of bulk propagation and clonal propagation.

1752 Monteuuis, O; Bon, M.C; Goh, D.K.S. 1998. **Propagation of teak by *in vitro* culture**. Bois et Forests des Tropiques 255: 19-29.

Propagation of teak by in vitro culture were assessed from the point of view of developing a protocol or production of plant material for forestry in Sabah, Malaysia. Plants obtained in vitro could be further micropropagated. The prospects of in vitro culture for propagating selected teak genotypes compared to propagation by rooted cuttings are discussed.

1753 Monteuuis, O; Bon, M.C; Goh, D.K.S. 1998. **Teak propagation by in vitro culture**. Bois et Forests des Tropiques 256: 43-53.

An English translation of a paper published in the journal Bois et Forets des Tropiques 255.

1754 Monteuuis, O; Goh, D.K.S. 1999. **About the use of clones in teak**. Bois et Forests des Tropiques 261: 28-38.

An account is given of research conducted in Sabah, Malaysia into the mass propagation of teak clones using cuttings or microcuttings. Production of clones on their own roots can be used for the improvement of planting material. Clonal propagation techniques can be used for establishing clonal seed orchards.

1755 Monteuuis, O; Vallauri, D; Poupard, C; Hazard, L; Yousof, Y; Wahap, L.A; Garcia, C; Chauviere, M. 1995. **Mass clonal propagation of mature teak trees (*Tectona grandis*) by rooted cuttings**. (French). Bois et Forests des Tropiques 243: 25-39.

Prospects for mass clonal propagation of 5- to 15-year-old teak trees by rooted cuttings were assessed in Sabah, Malaysia. The first generation of clonal offspring from *in situ* mature trees were produced by various propagation techniques - grafting, mound layering and shoot cuttings.

1756 Mundt, T. 1997. **Vegetative propagation of teak (*Tectona grandis*) by cutting**. TEAKNET Newsletter 7: 3-4.

Details are given of a procedure developed in Myanmar by the Tree Improvement Division of the Forest Research Institute.

1757 Muralidharan, E.M. 1997. **Micropropagation of teak, rosewood and sandal**. KFRI Research Report 119: 20p. Kerala Forest Research Institute, Peechi.

In teak, shoot tip and axillary bud collected from seedlings and from mature trees were used to initiate shoot cultures. In teak, sprouting of shoot tip and axillary bud was found better in seedling than in mature trees. The effect of cytokinins on shoot multiplication was tested in mature tree cultures and higher levels of benzyl aminopurine and kinetin were found to favour shoot multiplication.

1758 Nadgauda, R.S; Kendurkar, S.V; Kulkarni, V.M; Jana, M.M; Mascarenhas, A.F. 1997. **Advances in micropropagation of teak in IUFRO symposium 1997**. Forest Tree Science and Nursery Technique, Raipur, India.

1759 Nadgauda, R.S; Kendurkar, S.V; Kulkarni, V.M; Jana, M.M. 2000. **Biotechnology for the improvement of teak (*Tectona grandis* Linn.f.)**. Potential and Opportunities in Marketing and Trade of Plantation Teak, Challenge for the New Millennium, Yogyakarta, Indonesia, 31 July-August 2000.

1760 Nadgauda, R.S; Kendurkar, S.V; Kulkarni, V.M. 2003. **Tissue culture for improved productivity of teak**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Tissue culture is used for improved productivity through clonal multiplication of the superior plants. This was the first report on teak tissue culture indicating the possibility of application of tissue culture to forestry. The micropropagation technology was further refined and was used for scaling up of production of plants using elite/plus trees of teak and field planted at different locations in India. The presentation include work carried on improvement and up scaled of the micropropagation technology and field planting of the tissue culture raised propagules of teak.

1761 Nanda, K.K; Purohit, A.N; Adarsh Bala. 1968. **Seasonal rooting response of stem cuttings of some forest tree species to auxins**. Indian Forester 94(2): 154-162.

Rooting response of stem cuttings of thirty five tree species including teak were studied with different auxins and seasons. The results show that plant species vary markedly in their ability to root, planting season has a pronounced effect on rooting of the cuttings and effectiveness of auxins on rooting of cuttings varies with the season.

1762 Narasimhan, R; Dhruva, B, et. al. 1970. **Tissue culture on some woody species**. Proceedings of the Indian Academy of Sciences 71B(5): 204-212.

Describes different methods of growing tissue cultures of woody species including *Tectona grandis*. Teak grow well at a lower temperature on Murashige and Skoog's medium containing 1.0 p.p.m. of glycine.

1763 Nautiyal, S; Rawat, M.S; Pankaj Khullar. 1994. **Macropropagation of teak (*Tectona grandis* Linn.f.)**. Indian Forester 120(2): 146-151.

A review with particular reference to India and including accounts of grafting, budding and rooting of shoot cuttings.

1764 Nautiyal, S; Singh, U; Gurumurti, K. 1991. **Rooting response of branch cuttings of teak (*Tectona grandis*) as influenced by season and growth hormones**. Indian Forester 117(4): 249-255.

Branch cuttings were collected from young trees raised from seedlings and cuttings and old trees raised from cuttings. Cuttings were treated by dipping into solutions of IAA, IBA, NAA and IBA + NAA for 24 h and then planted in a soil/sand mixture in pots. Data on rooting and callusing after 120 days are presented and analysed.

1765 Nautiyal, S; Singh, U; Gurumurti, K. 1992. **Rooting response of branch cuttings of teak (*Tectona grandis*) as influenced by growth hormones and position of the cutting on the crown**. Indian Forester 118(2): 112-121.

Branch cuttings were treated with IAA, IBA and IAA + IBA solutions by dipping the basal portions for 24 h, and then planted in pots in soil/sand. Hormone treatments promoted rooting, but the responses varied with tree origin and growth in terms of numbers, while IAA promoted root length growth but not root numbers.

1766 Newman, H.L. 1931. **Root and shoot cuttings of teak as compared with nursery transplants**. Indian Forester 57(10): 528-529.

The advantages of raising teak plantations with root and shoot cuttings rather than nursery transplants in respect of vigour and less damage from an accidental fire is demonstrated.

1767 Noerhadi, E; Wirjodarmodjo. 1980. **Vegetative propagation of *Tectona grandis* Linn.f. and *Pinus merkusii* Jungh. et de Vries using tissue culture**. (English; Indonesian). Duta Rimba 6(42): 11-15.

1768 Pal, M. 1980. **Vegetative propagation of teak by rooting stem cuttings**. The Secondary Forestry Conference, Vol. II: 145-148.

1769 Palanisamy, K; Ansari, S.A; Mandal, A.K. 1995. **Standardization of vegetative propagation technology of teak, sisoo, neem, karanj and bamboos**. Proceedings of the International Workshop on Forestry Research Methods, Dehra Dun: 18-19.

1770 Palanisamy, K; Gireesan, K; Hegde, M. 2003. **Clonal propagation technology for teak for production of improved planting stock**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute,

Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Clonal propagation technology for mature teak trees and quality seedlings has been standardized. Indole butyric acid was found to be the most effective auxin for adventitious rhizogenesis in teak. Cuttings from coppice shoots of mature trees rooted between 72-91 percent in different seasons, while the cuttings from 1-2 year old stumps gave 79-100 percent rooting throughout the year.

1771 Palanisamy, K; Subramanian, K. 2001. **Vegetative propagation of mature teak trees (*Tectona grandis* Linn.f.)**. Silvae Genetica 50(5/6): 188-191.

Clonal propagation technology for mature teak trees is achieved for the first time. Indole butyric acid (IBA) was found to be the most effective auxin tested. Cuttings from coppice shoots of mature trees rooted between 74 to 91 percent with a 2000 ppm IBA treatment, while the cuttings from 1 to 2 year-old root-stocks rooted between 79 to 100 percent with 1000ppm IBA applied at different times of the year.

1772 Paosujja, R. 1971. **Teak: Vegetative propagation**. Proceedings of the Second Forestry Conference, Royal Forest Department, Bangkok R.129: 214-221.

Progress and problems encountered during vegetative propagation work of teak in Thailand are presented.

1773 Pianhanurak, P; Piyapan, P. 1996. **A preliminary study of rejuvenation of teak by the budding technique**. ASEAN Forest Tree Seed Centre Project, Thailand: 7p.

Shoots from mature buds grafted on stumps were rooted along with shoots from seedlings. Rooting vigour of seedling shoots was found better than that of shoots from the grafted buds. The rooting percentages were similar. Rooting of cuttings from grafted mature buds can be used for orchard establishment.

1774 Rahman, A.H.M.M. 1977. **Vegetative propagation of few forest species**. Bano Biggyan Patrika 6(1): 51-57.

Various propagation trials of various species including teak were performed in Bangladesh in 1973-75. Bud grafts were found successful. The rooting response of stem cuttings was increased by treatment with IAA or IBA at 10 and 100 p.p.m.

1775 Ratanakoses, S; Bhyndum, K. 1968. **Budding technique**. Progress Report Thai-Danish Teak Improvement Centre: 7p.

Budding experiments by forket method using the four different methods are described.

1776 Rawat, M.S; Kedharnath, S. 1968. **Field grafting and budding in teak (*Tectona grandis* Linn.f.)**. Indian Forester 94(3): 259-262.

Budding and cleft grafts proved equally successful. Best results were obtained in April and May at Dehra Dun.

1777 Rawat, M.S; Lakshmikantham, D; Kedharnath, S. 1973. **Bud grafting and growth of the grafts in teak**. Forestry Conference (Silvicultural Conference), 6-10 December 1973. Forest Research Institute, Dehra Dun.

1778 Reddy, S.K; Nagaraju, S; Shrihari, P.V; Farooq, S.A. 1997. **Rapid in vitro propagation of teak (*Tectona grandis* Linn.f.)**. Indian Forester 123(8): 778-780.

Seeds were prepared from ripe fruits collected in Andhra Pradesh, washed, and soaked in GA3 at 10 mg/litre. There was 100 percent germination after sterilizing with $HgCl_2$ and cultured on (1) MS basal medium with 3 percent sucrose at pH 5.4 and (2) autoclaved vermiculite + 1/4 MS constituents, in a growth chamber under a light/dark regime.

1779 Rowntree, J.B. 1942. **Propagation of teak by stem and branch cuttings**. Indian Forester 68(7): 396-397.

12" long teak cuttings placed horizontally in soil at 6'x6' spacing, at a depth of 1.5" were planted in April 1940. The cuttings are 2/3 inch in diameter. In all 87 percent of cuttings struck root by their week of May. By December, the plants are 5.5 ft. in height and after two growing seasons average height was found 4'3". At the end of two years 63 percent survival was found and all grafts have a normal root system.

1780 Ryan, G.M. 1904. **Reproduction by root suckers**. Indian Forester 30(9): 450-458.

Lists the species which produce root suckers. Teak reproduction from root suckers in Thana district has been briefly described.

1781 Seth, S.K; Mathauda, G.S. 1959. **Preliminary trials with gibberellic acid**. Indian Forester 85(9): 528-532.

Results of two trials conducted at New Forest with the object of studying the effect of gibberellic acid on tree seedlings including *Tectona grandis* are described. The stronger solutions gave greater height growth. With weaker solutions the plants were quite healthy and possessed well developed root systems.

1782 Shanmugavelu, K.G. 1966. **Studies on the effects of plant growth regulators on the seedlings of some tree plant species**. South Indian Horticulture 38(1/4): 24-35.

Seedlings of twenty tree species including teak were subjected to spray, soaking and lanolin-paste treatments with IAA, IBA, NAA, Chlorophenoxy-acetic acid (CPA) and gibberellic acid at various concentrations. The effects of the treatments on shoot and root production are tabulated.

1783 Sharma, S; Rana, P.K; Mandal, A.K; Ansari, S.A. 2000. **Promotion of in vitro shoot multiplication by Vipul (Triacontanol) and adventitious rhizogenesis by rice bran extract in *Tectona grandis***. Journal of Plant Biology 27(3): 265-269.

An economical micropropagation procedure for producing clonal planting stock from mature teak trees has been developed by inclusion of Vipul along with BAP for in vitro shoot multiplication and alcoholic rice bran extract alone for in vitro adventitious rhizogenesis in MS liquid media.

1784 Sharma, V.K; Uniyal, D.P. 2003. **Delayed graft incompatibility in heteroplastic interspecific graft between *Tectona grandis* Linn.f. and *Tectona hamiltoniana* wall after three decade**. Silvae Genetica 52(1): 24-25.

Extremely delayed graft-incompatibility and mortality of interspecific heteroplastic grafts of *Tectona grandis* and *T. hamiltoniana* after three decades was reported. Possible causes of incompatibility are discussed.

1785 Singh, S.P. 1994. **Grafting of teak for clonal teak seed orchard**. Vaniki Sandesh 18(2): 13-19.

In Madhya Pradesh.

1786 Siril, E.A; Tiwari, S.K. 1999. **A method for the synchronization of rooting and hardening of micropropagated shoots of teak (*Tectona grandis* Linn.f.) under ex vitro conditions**. Journal of Tropical Forestry 15(3): 229-232.

A procedure for the ex vitro rooting of micropropagated shoots of *Tectona grandis* has been developed. In vitro shoots harvested after 10 subcultures were dipped into auxin for two minutes and maintained in mist chamber conditions. The protocol described thus combined both rooting and hardening of in vitro raised shoots.

1787 Sita, G.L; Swamy, B.V.R; Puri, S. 1998. **Application of biotechnology in forest trees - clonal multiplication of sandalwood, rosewood, eucalypts, teak and bamboos by tissue culture in India**. Tree improvement: Applied research and technology transfer: 233-248. Science Publishers, Enfield.

The paper examines problems in conventional tree improvement programmes and the role of tissue culture in forestry and presents case studies for successfully micropropagated trees in India including teakwood.

1788 Sumantakul, V; Yingransiri, T. 1979. **Bud grafting of *Tectona hamiltoniana* onto *Tectona grandis* stock**. (Thai). Report on Silviculture 1977-1978. Ministry of Agriculture and Cooperatives, Bangkok. Royal Forest Department, Silviculture Division.

1789 Swaminathan, C; Srinivasan, V.M. 1996. **Seedling invigoration through plant growth substances in teak (*Tectona grandis*)**. Journal of Tropical Forest Science 8(3): 310-316.

The influence was studied of plant growth substances as promoters of seedling growth in teak stumps of nursery seedlings in Tamil Nadu. The slurry treatment method was used and growth of seedlings was monitored.

1790 Tewari, D.N. 1992. **A practical guide on clonal propagation of teak**. Ecosystems Research and Development Bureau, Philippines: 37p.

1791 Thompson, G.W. 1906. **A curious teak coppice shoot**. Indian Forester 32(10): 503-504.

1792 Tiwari, S.K; Tiwari, K.P; Siril, E.A. 2002. **An improved micropropagation protocol for teak**. Plant Cell, Tissue and Organ Culture 71(1): 1-6.

1793 Umboh, I; Setiawan, I; Kamil, H; Yani, S. 1989. **Use of in vitro culture techniques for multiplication of tropical forest tree species**

in Indonesia. (French). Les apports recents de la biologie vegetale en regions tropicales. Colloque en hommage au Professeur G. Mangenot organise a Orsay du 16-18 Novembre 1988. Bulletin de la Societe Botanique de France, Actualites Botaniques 136(3/4): 179-184.

Rejuvenation of adult trees and a three-step bud culture are described for six species including *Tectona grandis*.

1794 Uniyal, D.P; Rawat, M.S. 1995. **Effect of temperature and relative humidity on grafting and budding of teak (*Tectona grandis* Linn.f.)**. Indian Forester 121(6): 510-513.

Cleft grafting and patch budding are highly successful methods for clonal propagation of teak. Cleft grafting is a less economical method than patch budding in terms of time, material and work. Percentage success can be increased by the use of the greenhouse or mist chamber.

1795 Vakshasya, R.K; Rawat, M.S. 1985. **Evaluation of budding and field planting periods for teak seed orchard establishment**. Indian Forester 111(5): 328-332.

Teak scions were budded onto 2-yr-old stumps which were then transplanted into polythene pots subsequently planted out in the seed orchard. Plants derived from budding in March and field-planted in July gave the best results.

1796 Wang, B.S; Cao, Y.H; Huang, L.S. 1980. **Stem tip culture of teak in vitro**. Acta Botanica Sinica 22(2): 200-201.

1797 Warren, W.D.M. 1935. **Seedlings versus root and shoot cuttings**. Indian Forester 61(7): 465-466.

Teak seedlings from root and shoot cuttings of June 1933 planting gave 11' height in December 1934 and entire transplants of July 1933 looked poor and miserable are only 3' in height, while at the end of 1st year nearly 6" high with 59 percent casualities and one year behind in growth than root and shoot cuttings.

1798 White, K.J; Gavinlertvatana, P. 1999. **Vegetative reproduction of teak: The future to increased productivity**. Regional Seminar on Site, Technology and Productivity of Teak Plantations, Chiang Mai, Thailand, 26-29 January 1999.

1799 Winit-Rakchat. 1978. **Comparison of growth performance of stored and freshly prepared teak stumps**. (Thai). Proceedings of the 1978 National Forestry Conference, Thailand, 6 Nov 1978: 44-49. Ministry of Agriculture and Cooperatives, Bangkok.

1800 Yasodha, R; Sumathi, R; Gurumurthi, K. 1998. **Commercial micropropagation of teak**. Proceedings of Industrial-cum-Demonstration Workshop on Clonal Forestry, Coimbatore: 84-86. K. Subramanian; K. Gurumurthi; R.S.C. Jayaraj; K.C.S. Warrier, Eds.

1801 Yasodha, R; Sumathi, R; Gurumurthi, K. 2003. **Tissue culture strategies for quality planting stock production of teak**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

A total of 800 ha. of clonal seed orchard is established which can provide 15-16 million seedlings of good planting stock. Micropropagation technique was established to quantitatively enhance production of genetically improved planting stock using the seeds of clonal seed orchards. Comprehensive method for good shoot multiplication, cost effective rooting and application to a wide range of genotypes was developed. Seedlings raised from seeds collected from different clones in clonal seed orchard were used for culture establishment. Effects of cytokinins, solidifying agents, method of subculturing on shoot proliferation of teak were also discussed.

1802 Zope, J.S; Mukewar, A.M; Marawar, S.S. 1997. **Different techniques of vegetative propagation in teak**. PKV Research Journal 21(2): 206-207. Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola.

Four methods were tested for vegetative propagation of teak: air layering of coppice shoots, trench mounding, cleft grafting and shoot cuttings. Callus formation, sprouting, rooting and survival were recorded for each technique. Callus formation occurred in all methods, but only after IBA treatment.

Go top

Plantation Establishment

(See also 1590, 3796)

1803 **Cultivation of teak in Java**. Indian Forester 27, 1891: p448.

Contains province-wise figures of natural and plantation teak of Java.

1804 **Cultivation of teak in Dutch Netherlands**. Indian Forester 23(6), 1897: 195-201.

A translation describing teak forest of Java and cultivation method of teak under plantation contracts by local cultivators.

1805 **The cultivation of teak in Java**. Tectona 7, 1914: 190-192.

1806 **Respective merits of transplanting or direct sowing of teak in Puri, Orissa**. Indian Forester 46(2), 1920: 87-88.

Advantage of planting in lines is also discussed.

1807 **Stump planting of teak in dry localities**. Indian Forester 66, 1940: 682-683.

A discussion on Laurie (1940) original article on premonsoon stump planting of teak.

1808 **Annual report on silvicultural research in the Madras Presidency for the year 1940-41**. Superintendent, Government Press, Madras, 1942: 146p.

Experiments in the stump planting of teak show that early stump planting is advantageous and that planting the stumps with the top of the 1-inch shoot flush with the ground is beneficial both as regards survival and height growth.

1809 **Teak. The most valuable Asiatic tree species can easily be cultivated in Argentina**. (Spanish). Mundo maderero 5(61), 1945: 7-8.

Trials with teak in Argentina have indicated that it can easily be acclimatized to conditions in that country and it seems that its cultivation may be possible on a commercial scale. Brief notes are given on the preparation of the seed, nursery technique, sowing, spacing and time of planting.

1810 **Discussion on teak plantation establishment**. 2nd Regional Seminar on Teak, Yangon, Myanmar, 1995.

1811 Aimufia, D.I. 1972. **Report on Oria teak plantation**. Bulletin of the Nigerian Forestry Departments 32(2): 10-17.

Briefly describes the present condition of the small stand of *Tectona grandis* established at Oria in southern Nigeria in approximately 1911 and concludes that the plantation contains good-quality teak.

1812 Alphen de Veer, E.J van. 1956. **Teak cultivation in Java**. Proceedings of the 4th World Forest Congress, Dehra Dun, 1954: 322-328.

Describes and discusses the taungya method of establishment and underplanting with *Leucaena glauca*, which are the standard practice in Java and gives the yield table.

1813 Altona, T. 1927. **Age of the teak forests in the North-Eastern part of the residency of Madioen**. (Indonesian; English). Tectona 20: 1-16.

It is considered that the teak forests must have been developed in the region during the last 600 years. Mixed forests must have originated from abandoned local agriculture and present teak forests planted for economic use and to meet local requirements.

1814 Amoyaw, M.A. 1974. **Species trials on the Accra Plains and the establishment of Kpong Research Centre**. Forest Products Research Institute, Ghana, Technical Newsletter 8(1/2): 17-19.

The Kpong Research Centre was set up in 1955 to determine which tree species could be grown on the black cotton soils of the Accra Plains, and to develop suitable methods of planting and tending these trees. Numerous exotic and indigenous species including *Tectona grandis* were planted on the 21.8 ha area, prepared by burning, the removal of stumps and disc-ploughing.

1815 Aniwat Thunyathorn. 1989. **Estimating land suitability for *Pinus khasya* and *Tectona grandis* reforestations of Mae Chaem watershed in Changwat Chiang Mai (Thailand)**. Kasetsart university, Bangkok: 128 leaves.

Result of growth factor analysis showed that 13 percent of the total watershed area of 4,107 sq.km. was found suitable for *Tectona grandis*.

1816 Apichart Kaosa ard. 1995. **Overview problem in teak plantation establishment**. 2nd Regional Seminar on Teak, Yangon, Myanmar.

1817 Arce-Brenes, H; Arroyo-Castillo, E. 1981. **Establishment of permanent plots planted in common teak and Malay bushbeech**

(*Gmelina arborea*) **in Cabuya Monctezuma, Puntarenas**. (Spanish). Instituto Tecnologico de Costa Rica, Cartago, Costa Rica: 82p.

1818 Asiddao, F. 1959. **Progress report on sample plots**. Fillipino Forester 11: 69-77.

By 1959, 334 permanent sample plots had been established in the Philippines since the war. Their location, date of establishment and the number of measurements taken are tabulated. Results of some preliminary analyses of post-war data are given.

1819 Bajdalina, N.A. 1964. **First experience of organising work on forest physiology in the Democratic Republic of Vietnam**. (Russian). Problemy Exologii Fiziologii Lesynh Rastenij 2: 37-60.

Describes the setting up of an organization for the study of tree physiology in N. Vietnam with Russian assistance. Teak is one of the species studied. Measurements are tabulated of the daily and seasonal variations in transpiration, photosynthesis and respiration of several indigenous and exotic species. Relationship of photosynthesis to light and seasonal variation of chlorophyll content was studied for these species including teak.

1820 Ballantyne, J (et al). 1875. **Transplanting versus direct sowing of teak in India**. Indian Forester 1: 191-196; 413-414.

In the case of large and strong plants, cutting of tap-root is required before transplanting. When the plants are small and weak and ground light and dry, less interference with tap-root is better, transplanting experiments with teak in several localities and authors' experience in this regard are given.

1821 Barrance, A.J. 1988. **The potential of *Tectona grandis* (teak) in Vanuatu**. Forest Research Report, Vanuatu 1/88: 9p.

Experience with teak in Vanuatu is described. Silvicultural characteristics and requirements, pests and diseases, susceptibility to cyclone damage and utilization are discussed. The species appears to be of considerable potential and the establishment of large-scale provenance trials is recommended.

1822 Becking, J.H. 1928. **The growing of teak in Java**. Korte Meded Van het Boschhouw Proefsta 22; Forest Research Station Report 22.

1823 Becking, J.H. 1932. **The present position and future outlook on teak cultivation**. (Dutch). Tectona 25: 873-912.

1824 Beekman, H.A.J.M; Wechel, A Te. 1930. **Notes on teak (*Tectona grandis*) cultivation systems**. (Indonesian; English). Tectona 23: 149-165.

1825 Beyse, R. 1991. **Successful establishment of a teak plantation in Brazil**. (German). Forst und Holz 46(20): 563-564.

Successful establishment of fast-growing plantations of teak by a German-owned sawmilling company at Caceres, Mato Grosso, Brazil is described. The rotation is 25 years and yield is 320-330 m3/ha.

1826 Bhola, M.P. 1939. **Teak planting in Gorakhpur**. Indian Forester 55(10): 562-563.

Local seed as good as imported Burma seed, while Jhansi seed is poorest in germination and development of seedlings; (1) thus local seed of original Burma origin over 50 years has acclimatised; (2) temporary nurseries in planting site are preferred; and (3) teak cuttings planted in simple holes of 9-12 in. are good and gave satisfactory results.

1827 Bhuijan, A.A. 1979. **Afforestation of unclassed state forests lands areas in Chittagong Hill Tracts of Bangladesh**. Bano Biggyan Patrika 8(1/2): 64-70.

This paper discusses factors to be considered in formulating a compensatory afforestation programme for the infertile and denuded Hill Tracts. Factors discussed are choice of species, nursery practice, plantation establishment, use of fertilizers, pest control, labour supply and the importance of good forest road networks.

1828 Bos, J.H. 1934. **Remarks on the replanting of unsuccessful teak plantations in Padangan forest**. (Dutch; English). Tectona 27: 441-443 .

1829 Brandis, D. 1880. **On teak planting in Bombay**. Indian Forester 5: 307-310.

Reports on teak planting along the Kalinandi river. Suggests growing mixed forests and leaving unfelled jungle strips in between. Problems of raising, management and fire protection are discussed.

1830 Brascamp, E.H.B. 1910. **A trial cultivation**. Tectona 2: 172-174.

1831 Brascamp, E.H.B. 1916. **Have they tried to plant teak in South France etc?** (Indonesian; English). Tectona 9: 413-415.

1832 Brascamp, E.H.B. 1916. **How people in 1860 cultivated teak plantations**. Tectona 9: 481-484.

1833 Brascamp, E.H.B. 1921. **Memories of Governor of Ceylon Mr. W.J. van e Graaf and J.G. van Angelbeek in 1794 about teak cultivation, in Kolonial Archief No. XXV**. Tectona 14(2): 929-931.

1834 Budowski, G. 1960. **Reforestation of areas not suitable for Cacao**. (Spanish; English). Proceedings of 8th Inter-American Cacao Conference, Trinidad and Tobago: 428-435.

Tectona grandis is one of the species suggested for reforestation of steep and low fertility sites.

1835 Burman, W. 1883. **Teak cultivation**. Agriculture University, Wageningen.

1836 Burman, W. 1892. **Teak cultivation in Java**. Indian Forester 18: 285-292.

Describes the artificial cultivation methods followed for teak in Java.

1837 Butt, R.A. 1962. **Trials of species for timber planting in the savanna woodland zone of North Uganda**. British Commonwealth Forestry Conference, East Africa: 32p. Government Printer, Entebbe.

Describes some of the trials that are being made in Northern Uganda to replace uneconomic Terminalia/Combretum woodland with timber species most promising of these is teak.

1838 Chable, A.C. 1967. **Reforestation in the Republic of Honduras, Central America**. Ceiba, Tegucigalpa 13(2): 1-56.

Seed collection, propagation, planting, spacing, tending, soils and drainage, pests and diseases etc. are of different species including *Tectona grandis* are briefly discussed.

1839 Chaplin, G.E; Neumann, A.J. 1987. **Afforestation on the Guadalcanal grasslands**. Forest Division, Solomon Islands, Forestry Note 18-2-87: 17p.

The potential benefits and problems of afforestation on these grasslands at Honiara, Solomon Islands are considered. Basic information on the site relevance to afforestation is given and possible objectives of a programme, existing trials and expected growth rates reviewed. Silvicultural recommendations are made, including the suggestion of *Tectona grandis* as the most appropriate species with smaller scale planting of *Samanea saman*.

1840 Chollet, A. 1952. **Report on Togo**. (French). Proceedings of the 1st Conference of Forestry Inter African Countries, Abidjan, 1951: 269-282.

Covers policy, fires and cultivation of teak; reforestation in the savanna is also included.

1841 Classen, J.C van R. 1916. **Working plan of cultivation of teak by coolies in the Nagawi forest section etc**. (Indonesian; English). Tectona 9: 181-195.

1842 Cooling, E.N.C; Endean, F. 1967. **Preliminary results from trials of exotic species from Zambian plantations**. Forest Research Bulletin, Forest Department Zambia 10.

1843 Copleston, W.E. 1914. **Cultivation of natural teak seedlings in the Haliyal teak pole forests worked on coppice with standards system**. Indian Forester 40(9): 461-463.

Describes the method of experimental cultivation of natural seedlings occurring plentifully in forest in the rainy season to make them survive summer-drought in Dharwar area.

1844 Corner, E.J.H. 1952. **Wayside trees of Malaya**. Government Printing Office, Singapore 1: 705-706.

Describes *Tectona grandis* introduced from Burma, giving a general description of tree and growth conditions in Malaya.

1845 Dacanay, P. 1946. **Progress of reforestation in the Philippines**. Rev. Int. Prod. colon. 196-197: 10-15.

An account is given of forest legislation in the Philippines and of the various reforestation projects undertaken by the Bureau of Forestry either for conservation purposes or to provide firewood. Certain important species including *Tectona grandis* has been found successful for reforestation.

1846 Danaatmadja, O. 1991. **Establishment of industrial plantation forests by Perum Perhutani in East Nusa Tenggara Province: A view of the establishment in Kupang region**. Duta Rimba 17(135/136): 2-7 (In); 8-11 (En).

The main species planted include teak.

1847 Deventer, A.J van. 1910. **Cultivation with respect to profits and regulations of operations**. (Dutch; English). Tectona 2(1): p328.

1848 Divekar, M.V. 1933. **Early stump planting of teak in Kanara North Division**. Indian Forester 59(9): 584-588.

Reports results of an experimental trial of early stump planting of teak and quotes good results obtained in moist areas of North Division Kanara and teak pole area of Haliyal range which is comparatively a drier area.

1849 Drees, E.M. 1954. **Silvicultural problems in dry monsoon areas in Indonesia**. Tectona 43(1/2): 111-118.

Dry monsoon areas are defined as those lowland regions that are unsuitable for teak plantations, owing to deficiency or unfavourable distribution of rainfall. Possibilities of afforestation are discussed.

1850 Dupuy, B. 1991. **Afforestation and reforestation**. World Forestry Congress, Paris, September 17-26, 1991.

1851 Eckert. 1905. **Cultivation of teak in Tanganyika**. Forestry in German East Africa 2: 285p.

1852 FAO. 1874. **Guide for the planting and cultivation of teak trees in Government forests in Java and Madura**. Official Gazette 214, 1874. FAO/TSC, Bangkok, 1956.

Reference to bibliography on teak: Country report Indonesia in 1st session of FAO/TSC Bangkok, 1956.

1853 FAO. 1968. **Man-made forests: Establishment methods and techniques**. FAO world symposium on man-made forests and their industrial importance. FAO, Rome.

A paper on teak planting in Tanzania is also included.

1854 Feungchan, S; Bunpromma, K; Srinukool, S; Rungsimanop, C. 1996. **Preliminary study on cultivation of commercial timbers**. Khon Kaen Agriculture Journal 24(3): 132-134.

Information on the cultivation of commercial timbers including *Tectona grandis* is included.

1855 Firdaus, A.Ch. 1979. **Trial of teak forest cultivation**. (Indonesian). Gema Rimba 5(39-40): 57-60.

1856 Forest Department, Kenya. 1940. **Stump planting**. Research Bulletin, Forest Department, Kenya 1: 3p.

Results of the experiments to discover with what degree of success over nursery stock in Kenya stumped and planted out are presented. In the moist climate of Kakamega, transplants and stumps of Burma teak both grew well, but the latter are found much simpler to raise in the nursery.

1857 Forest Department, Nigeria. 1947. **Fuel plantations in Nigeria**. Report Forest Administration, Nigeria 1945-46: 14p .

Teak is the most successful fuel and pole crop on good soils where there is an adequate rainfall.

1858 Forest Department, Nigeria. 1964. **The role of forestry in the economic development of the savanna areas of Nigeria**. Proceedings of the 1st Nigerian Forestry Conference, Kaduna, 1964: p189.

A conversion system for the management of coppiced teak plantations is discussed.

1859 Forest Department, West Bengal. 1955. **Bamanpokri teak plantations, Kurseong Division**. Forest Department, West Bengal: 10p.

Gives an account of the establishment, performance, growth data etc., of mixed plantations of teak with sal and other species, established 1868-88, and of a new series started in 1941.

1860 Forest Department, Zanzibar. 1952. **Afforestation of Semi-wanda areas**. Report of Department of Agriculture, Zanzibar 1950: 15-16. Forest Department, Zanzibar.

Special trial plots were initiated to fix up possibility and suitability of species for afforestation of brushwood country consisting mainly of *Heteropogon controtus* Sward on coral soils. Teak is one of the less successful species with good growth, seedlings were planted in holes prepared in the coral rocks filled with soil.

1861 Fraser, H. 1956. **Forest preservation in the Windward Islands**. Caribbean Forester 17(1/2): 25-28.

A note on the local value of forests with recommendations for their treatment. Teak is found best for the open land with poorer vegetation.

1862 Garcia, C.J.R. 1978. **Preliminary evaluation of experimental plantings of forest trees in savannas in the El Irel Experiment Station at Barrancas, Barinas State, Venezuela**. Revista Forestal Venezolana 28: 97-143.

Survival and growth of the forest species including teak were evaluated in pure or mixed plots from 1969 to 1973. Teak was one of the most promising species for afforestation of savannas in the Llanos Occidentales region of Venezuela.

1863 Geary, T.F; Briscoe, C.B. 1972. **Tree species for plantations in the granatic uplands of Puerto Rico**. Forest Service Research Paper ITF-14 (September 1972): 3p. Institute of Tropical Forestry Rio Piedras, Puerto Rico.

Tectona grandis was planted with 80 percentage success out of thirty two species were tried.

1864 Ghosh, R.C. 1961. **Teak is introduced in the lateritic waste**. Proceedings of the 10th Silvicultural Conference, Dehra Dun, 1961 Part II: 368-377.

In the lateritic waste of West Bengal, different measures were taken to rehabilitate them with various forest species including teak for reforestation. Teak is found the most promising species.

1865 Ghosh, R.C. 1977. **Handbook on afforestation techniques**. Government of India, New Delhi.

1866 Guwaldi, S.V. 1945. **Post-war reconstruction and our forests**. Indian Forester 71: 342-345.

Teak was used much for construction purpose as supplies of teak were plentiful and fairly cheap before. Because of industrialisation it is suggested to encourage plantations of species likely to be useful in the development of big industries such as those of plywood, pulp, raw rubber, etc. The author proposes that there should be no exploitation beyond the minimum necessary, a complete enumeration of the stock of valuable timber especially teak, new working plans to suit the actual conditions and permanent restriction of teak exploitation to the minimum. An intensive planting programme and tending of existing plantations are the other requisites suggested for restoring the situation.

1867 Hamilton, A.P.E. 1947. **Chambal ravines reclamation scheme**. Indian Forester 73(3): 99-101.

An afforestation scheme was begun with the object of preventing erosion in areas adjoining the Chambal River in Gwalior State and providing firewood, small timber and fodder for the local population. Species which have done quite well include *Tectona grandis*.

1868 Hashim, S; Zainudin, H.M.A. 1983. **The planting of speciality wood in the state of Kedah**. Malaysian Forester 46(3): 316-326.

Teak is regarded as the most promising high-grade timber species for the dry region of Malaysia. Details are given of a planting programme begun by the Forest Department of this state in 1982 along main roads and in village communities and in 1983 in areas of derelict forest.

1869 Healey, S.P; Gara, R.I. 2003. **The effect of a teak (*Tectona grandis*) plantation on the establishment of native species in an abandoned pasture in Costa Rica**. Forest Ecology and Management 176(1-3): 497-507.

A study is made to examine the ecological effects of establishing a teak plantation on an abandoned pasture in southwestern Costa Rica. The understorey of a 10 year old teak plantation was evaluated in terms of structure, species richness and diversity. Recruitment in the plantation's understorey was then compared to the recruitment present in nearby abandoned agricultural land.

1870 Hedegart, T. 1988. **The teak (*Tectona grandis*) plantations at Longuza, Kwamkoro and Kolekole forest reserves - an evaluation of the existing plantations and their management and recommendations for amendments and future establishment practice**. Amani Forest Inventory and Management Plan Project, Helsinki: 15p.

1871 Hendaris, D. 1988. **The establishment of timber estates in Sumbawa, West Nusa Tenggara, in 1987/1988**. Duta Rimba 14(99/100): 16-28.

An account of the early work in the establishment of forest plantations including *Tectona grandis* in West Nusa Tenggara, Indonesia, under the auspices of the Timber Estate Programme of the Ministry of Forestry is given. Perum Perhutani, the Forest State Corporation of Indonesia has been assigned to plant an area of 30 000 ha.

1872 Higbee, E.C. 1944. **The canal zone experiment gardens**. Agriculture in the Americas 4(8): 146-147.

The organization founded in 1923 mainly to assist farmers is now producing seeds and seedlings of teak, rubber etc. and is also carrying out experiments on growing teak.

1873 Hoare, P; Patanapongsa, N. 1988. **Long-rotation, high value trees: An alternative strategy for private forestry**. Commonwealth Forestry Review 67(4): 351-361.

Based on the experience with *Tectona grandis* in N. Thailand, it is recommended for a change in forestry policy to promote *T. grandis* for private forestry and for social forestry projects.

1874 Hon, C.H; Matsumoto, K (Eds). 2000. **Proceedings of the seminar on high value timber species for plantation establishment - teak and mahoganies, 1-2 December 1998, Sabah**. JIRCAS Working Report 16: 124p.

Papers covering aspects of the establishment of enrichment planting in logged-over forests or reforestation on harvested areas, tending, pests and diseases, management, economics and yield, wood properties and marketing of teak and Mahogany are included. Six papers address experiences with teak in Malaysia.

1875 Jambhale, N.D; Patil, S.C; Patil, F.B; Patil, M.M. 1995. **Performance of eight tree species in saline soil at Rahuri**. Journal of Maharashtra Agricultural Universities 20(1): p118.

Performance of different tree species including *Tectona grandis* is evaluated.

1876 Kaewla-Iad, T. 1970. **Establishment period of teak at Mae-Huad Forest Lampang**. Proceedings of the 3rd National Forestry Conference, Royal Forest Department, Bangkok: 8p.

1877 Kartasubrata, Y. 1979. **Tumpangsari method for establishment of teak plantations in Java**. Tropical Agriculture Research Series 12: 97-105.

1878 Kaul, R.N; Gogate, M.G. 1993 . **Greening of forest grasslands in Nasik District**. 35p. National Afforestation and Eco Development Board, New Delhi.

An account is given of the work done in degraded forest areas in Nasik District, Maharashtra. About 9474 ha of degraded forest were developed by means of shrub, legume and grass propagation. This helped to a remarkable regeneration of endemic tree species including *Tectona grandis* in the area.

1879 Kayastha, B.P. 1976. **Planting hardwoods in the Tarai and Inner Tarai Region of Nepal**. Forestry 6: 3-9.

1880 Keh, K. 1996. **A review of the teak plantation establishment in Myanmar in the light of modern research findings: A constructive critique**. Forest Research Institute, Myanmar, Leaflet 1/95-96.

1881 Keth, S.K. 1997. **Whither goes Myanmar teak plantation establishment?** 11th World Forestry Congress, Turkey.

1882 Khan, M.A.W. 1973. **Rehabilitation of degraded teak forest**. Forestry Conference (Silvicultural Conference), 6-10 December 1973: p14. Forest Research Institute, Dehra Dun.

The degradation stage of teak forests are listed and a detailed review of the practices so far followed in rehabilitating these forests is given. The lacunae discovered in such management are high lighted. A new approach for thinning uneven teak stands of varying sized trees and differing growth potential is given. A new management system called preparatory improvement felling system is proposed as a specific remedy for rehabilitating high quality teak forests of degraded nature.

1883 Krishnapillay, B. 2002. **A manual for forest plantation establishment in Malaysia**. Forest Research Institute Malaysia, Kuala Lumpur: 286p.

This manual which includes information about the history of forest plantations in Malaysia, species for plantation consideration, soil, seeds, seedlings and planting stock, improvement of planting stock through selection and management of seed production areas, land clearing techniques without burning, plantation preparation, planting and tending, plantation diseases, insect pests, approaches to agroforestry and the financial analysis of plantation development with some examples. Details of the silviculture of species that are recommended for plantation development in Malaysia which include the silviculture of teak along with seven other species.

1884 Kumar, U; Jena, S.C. 1996. **Trial of integrated biotechnical approach in biological reclamation of coal mine spoil dumps in South-Eastern Coalfields Limited, Bilaspur (Madhya Pradesh)**. Indian Forester 122(12): 1085-1091.

A trial on biological reclamation was conducted at mine sites. Saplings of various multipurpose tree species including *Tectona grandis* were planted and inoculated with the cultures of mycorrhiza and Azotobacter. Between the rows of trees, mixtures of *Pennisetum pedicellatum, Heteropogon contortus* and *Stylosanthes hamata* were sown. This integrated approach has helped to control soil erosion, improve the physical and chemical properties of the soil and increase plant heights.

1885 Kumaran, S; Balasubramanian, V; Balasubramanian, A. 2003. **Screening of suitable tree species for the areas affected with tannery effluent**. Crop Research Hisar 25(3): 492-494.

A field experiment was conducted in Ranipet, Vellore in Tamil Nadu to investigate the tree species for areas affected with tannery effluent. The biometric observations like establishment percentage, plant height and number of branches per plant were recorded. Teak recorded poor establishment of 5.5 percent.

1886 Kunsi, E.D. 1923. **The status of cultivation question in teak forests**. (Dutch; German). Tectona 16: 817-822.

1887 Lanier, L. 1959. **Forest plantations in the central Ivory Coast**. (French). Revue Forestiere Francaise 11(8/9): 592-604.

An account of the region, methods of establishment and silvicultural treatment of teak plantations is given.

1888 Larp. 1972. **Laos-Australian reafforestation project (LARP)-Manual of operations**. Department of Foreign Affairs and Department of Forestry of Australian National University, Canberra, Australia and Forests and Water Department of Royal Laos Government Vieliane, Laos.

The manual includes information regarding the nursery, collection of seed from native trees, teak plantations in Laos and trial plots. The chapters on nursery and teak plantations deal with teak culture in great detail.

1889 Laurie, M.V. 1934. **Summary of current methods of raising teak plantations in Madras**. Proceedings of 4th Silvicultural Conference, Dehra Dun, 1934: p290.

1890 Laurie, M.V. 1940. **Pre-monsoon stump planting of teak in Upper Godaveri Division, Madras**. Indian Forester 66: 465-467.

Premonsoon planting experiments with teak root and shoot cuttings in Upper Godaveri Division show that best results are obtained by planting about three weeks before the break of the monsoon.

1891 Letourneux, C. 1952. **Reforestation**. Report to the Government of Thailand FAO/EPTA 47. FAO, Rome.

Deals with teak on the following heads-site assessment, silvicultural system, mechanization and planting.

1892 Levingston, R. 1967. **Reforestation with teak: Papua and New Guinea**. Pacific Bulletin 4: 41-44.

Plantations near Port Moresby are aimed at supplying timber and labour employment.

1893 Loetsch, F. 1958 . **The effects of shifting cultivation on the structure of tropical forests and river behaviour, as studied in Northern Siam**. (German). Repr. from. Erdkunde, Bonn 12(3): 182-205.

Analyses of the species composition of the closely intermingled parts of the forest containing or not containing teak suggests that the teak-free areas are secondary forests following shifting cultivation in the distant past, teak being by nature of its dispersal, the last species to reoccupy a site.

1894 Lopez Palacios, S. 1974. **Novelties in the Verbenaceae for Venezuela**. (Spanish). Pittieria 6: 13-28.

Includes descriptions of tree species including *Tectona grandis*, with notes of the places where they are cultivated in Venezuela.

1895 Louman, B; Leavasa, A; Ona, A. 1993. **Tree species selection for village woodlots on Markham Valley grasslands**. Klinkii 5(1): 4-10.

A tree species trial was set up at Atsunas, Papua New Guinea, on degraded grassland. Ten species including *Tectona grandis* were selected for the trial, based on their performance elsewhere and on the availability of seeds and other propagation material. 18

months after planting, only the two *Leucaena* spp. and *Tectona grandis* survived.

1896 Loyttyniemi, K. 1987. **On survival of mukusi (*Baikiaea plurijuga* Harms) seedlings in the teak forests and in the Copperbelt**. Division of Forest Research, Forest Department, Zambia, Research Note 40: 8p.

Survival of seedlings at Chati in the Copperbelt, was compared with that at Masese in the teak forests. In the teak forests all the planted seedlings perished two months from planting, mainly due to animal damage; the directly sown seedlings survived better.

1897 Lugt, C.S. 1908. **Cultivation of teak seedlings and the so-called contact cultivation**. Tectona 1: p174; p441.

1898 Lwin, K. 2003. **Enrichment planting with teak - A potential tool for rehabilitation of degraded teak bearing forests in Myanmar**. TEAKNET 31: 4-6.

Results of the work done to improve the regeneration density of teak in the degraded teak bearing forests of Myanmar by line planting are presented.

1899 Madoffe, S.S. 1980. **Performance of tree species at Longuza arboretum, Muheza, Tanzania**. Tanzania Silviculture Research Note 33: 13p.

Information from species trials at Longuza arboretum was assessed to find species suitable for afforestation for Longuza Forest Project.

1900 Maessen, P.P.T.M. 2001. **Aspects of teak cultivation in Costa Rica**. (Dutch). Nederlands Bosbouwtijdschrift 73(1): 6-18.

The development of teak plantations is described with special reference to predictions of average annual increment, teak quality and prices. The establishment and management of plantations is outlined and damage by forest fires, pests and plant diseases is described. The need for certification and monitoring of growth are discussed.

1901 Meniaud, J. 1931. **Cultivation of teak in tropical Africa**. Empire Forestry Journal 10: p125.

1902 Mensbruge, G de la. 1968. **Afforestation species for the savanna**. Conference on agricultural research priorities for economic development in Africa, Abidjan Vol. II. U.S. National Academy of Sciences, Washington: 346-354.

The most promising species in the Guinea savanna of the Ivory Coast include *Tectona grandis*.

1903 Mijers, W.N. 1941. **Reforestation in Madura**. (Dutch). Tectona 34: 909-939.

A survey was made in 1936 and a scheme of afforestation was presented. The species to be planted are listed. Teak is recommended for most of the lime soils.

1904 Mijers, W.N. 1941. **Reforestation in Madura**. Tectona 34: 505-506.

It is found that out of the forests of about 70,000 ha., 60,000 ha. were teak forest. These forests are found disappearing rapidly through overcutting and a scheme was approved for the reforestation of 20,590 ha. in 1939.

1905 Ministry of Agricultural and Water Resources, Nigeria. 1964. **Western Nigeria teak plantation project**. 30p. Ministry of Agricultural and Water Resources, Forestry Division, Ibadan, Nigeria.

1906 Moeljodihardjo, G. 1993. **Rehabilitation of Gombong Forest area**. Duta Rimba 1(153/154): 10-13.

Rehabilitation measures carried out in cooperation with the local community since 1988 are described in 4230.7 ha of degraded teak forest in Sewu range, South Gombong, Java. The measures involved agroforestry and social forestry techniques.

1907 Mohan, A; Kulkarni, P.K. 1995. **Improved technique of teak planting**. Indian Forester 121(6): 447-454.

An improved cost effective method for teak planting is described. The method involved planting stumps using a crow bar on mini-terraces formed on sloping areas in the Western Ghats of Maharashtra.

1908 Moore, D. 1966. **The formations of teak plantations by the group planting system**. Proceedings of the 6th World Forestry Congress, Madrid, Vol. 2: 2530-2533.

1909 Mueller, L.G. 1977. **The national reforestation programme in Liberia**. (German). Allgemeine Forstzeitschrift 32(39): 977-978.

Plantations of the species *Gmelina arborea* and *Tectona grandis* are being evaluated.

1910 Mulard, M. 1961. **Afforestation in Upper Volta**. (French). Centre Technique Forestier Tropical, Nogent-sur-Marne: 26p.

Nursery practice, plantation methods, costs and yields of plantations including *Tectona grandis* established between 1940 and 1960 are discussed.

1911 Naidu, K.K. 1957. **Past, present and future of planting teak in the Andamans**. Indian Forester 83(9): 539-545.

Teak planting was abandoned some twenty five years ago, but recent trials using modern techniques show promise. Recommended methods are careful choice of site, pre-monsoon planting preceded by clear-felling, burning and interplanting with a crop of hill paddy.

1912 Nicholson, D.I. 1974. **Restoration of bauxite mines at Weipa**. Department of Forestry, Queensland, Research Paper 5: 30p.

Trial plantings of various tree species have been made annually since 1967. A total of thirty four species have been planted; details are given of the eleven most promising species including teak.

1913 Niskanen, A. 1998. **Value of external environment impacts of reforestation in Thailand**. Ecological Economics 26(3): 287-297.

1914 Oever, H.Ten. 1908. **Cultivation of seedling under contract**. Tectona 1: p213.

1915 Oo, M.T; Hlaing, C. 1998. **Greater reforms in teak plantation establishment and management**. TEAKNET Newsletter, 10 March 1998.

1916 Osorio, R; Sutherland, S. 1993. **Cost of establishment of *Tectona grandis* in sites infested with *Saccharum spontaneum* in Quebrada Ancha, Colon, Panama**. Silvoenergia 53: 4p. Proyecto Cultivo de Arboles de Uso Multiple, Turrialba, Costa Rica.

1917 Parry, M.S. 1954. **Tree planting in Tanganayika IV, species for coastal areas: Teak**. Empire African Agricultural Journal 20(1): p49.

Trial plots indicated good growth of teak in moister lowland areas and foot-hills upto 3000 ft. Short notes was given on sites suitable and also on methods of planting.

1918 Patel, V.J. 1997. **Teak cultivation at Jivrajbhal Patel Agroforestry Centre**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 15-19. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

The paper discusses the technique developed to increase the rate of growth of teak under density plantation with soil working, irrigation, fertilizer and pesticide application. The plantation has shown excellent growth in terms of diameter and height, promising very high income.

1919 Pedroso, L.M. 1973. **Data on the present performance of exotic species in the region of central Amazonas**. (Portuguese). Brasil Florestal 4(16): 64-68.

Tabulates data on the performance of exotics including *Tectona grandis* planted on sites 70 and 150 m above mean river level.

1920 Perera, W.R.H; Ranatunga, M.S. 1972. **Forestry in Sri Lanka**. Sri Lanka Forester 10(3/4): 62-131.

Forestry Development Plan includes forest policy, long-term objectives of timber production, plans for planting 16 000 acres and staff requirements. Papers included are; A study of the protective benefits of the Wet Zone forestry reserves of Sri Lanka; Notes on the planting of forest species; and Forests, trees and timber including illustrated account of different types of plantation and the general use of chena or taungya in teak plantations.

1921 Periera, W.E. 1920. **Establishing teak in an area of mixed jungle species**. Indian Forester 45(10), 1919: 545-546; 46(3): 156-157.

Describes the method of raising teak successfully in a mixed forest without burning the area. Success of the plantation is attributed to elimination of all useless species, weeding of the entire area and aeration of the soil.

1922 Piotto, D; Montagnini, F; Ugalde, L; Kanninen, M. 2003. **Performance of forest plantations in small and medium sized farms in the Atlantic lowlands of Costa Rica**. Forest Ecology and Management 175(1-3): 195-204.

Evaluated the growth of the native and exotic tree species including teak plantations in small and medium sized farms in the Atlantic humid lowlands of Costa Rica.

1923 Popham, S. 1982. **Burma teak (*Tectona grandis*)**. Bulletin of Pacific Tropical Botanical Garden 12(3): 56-59.

Discussed the cultivation and wood properties of the Burma teak.

1924 Prasad, R. 1992. **Performance of teak stumps planted on coal mine overburden dumps at Dhanpuri, Shahdol in Madhya Pradesh**. Vaniki Sandesh 16(2): 3-4.

1925 Prasad, R; Dhuria, S.S. 1989. **Reclamation of iron-ore mined-out areas: Biomass production efficiency of species**. Journal of Tropical Forestry 5(1): 51-56.

Afforestation trials with seventeen species are reported from an opencast iron-ore mined out area at Dalli-Rajhara in the Durg district of Madhya Pradesh. Species tried included *Tectona grandis*.

1926 Raets, G.H. 1965. **Preliminary report on the cultivation of *Tectona grandis* in the Barinitas experimental area, Venezuela**. (Spanish). Boletin, Instituto Forestal Latino Americano 18: 29-40.

Gives brief information on the natural vegetation, climate and soils, an experimental area in Barinitas that seems to confirm to the optimum conditions for teak and describes the results of trials. Best results were obtained with 8-month-old stumped plants, spaced 2 X 2 m.

1927 Rodrigo, J.C.P.N.A. 1960. **The silviculture, origin and method of raising teak in Ceylon**. Southern Forest Rangers College Magazine 36(4): 30-32. Forest Research Institute, Dehra Dun.

1928 Rodriguez Marcano, A. 1963. **The cultivation of *Tectona grandis* in Venezuela: General information and preliminary results of some trials**. (Spanish). Revista Forestal Venezolana 6(8/9): 49-72.

Lists 10 plantations of importance in Venezuela and gives information on their climate, soils, history and development. The results indicate that conditions near the optimum for teak exist in parts of the country. Teak appears to hold great promise for Venezuela.

1929 Rodriguez, D; Fonseca, W. 1993. **Results of a species trial in Palmar Norte, Costa Rica**. Resultados de un ensayo de especies forestales en Palmar Norte, Costa Rica. Ciencias-Ambientales 9: 48-53.

The results are reported of trials with eleven species including *Tectona grandis*.

1930 Roosendael, J van. 1931. **Observations on cultivation of Tectona**. Tectona 24: 954-983.

1931 Ross, P. 1959. **Teak in Trinidad**. Economic Botany 13(1): 30-40.

A note on the method of establishing and tending and local utilization, including that of thinnings. Age class distribution in the 10,000 acres planted, yield table up to 20 years and finance of hot and cold impregnation are given.

1932 Sakurai, S; Cruz, L.U de la. 1993. **Growth of trees planted in degraded forest land**. JARQ, Japan Agricultural Research Quarterly 27(1): 61-69.

Fast growing tree species planted in the Makiling forest in Los Banos, Laguna and degraded forest land in Carranglan in the Philippines were examined to analyse the characteristics and productivity of these tree species in each area. Teak was a fire-tolerant species and gradually improved its growth.

1933 San Buenaventura, P. 1961. **Reforestation of Imperata waste lands in Philippines**. Philippine Journal of Forestry 14(1/4): 67-76.

An account of the reforestation scheme, with photos of plantations of teak and other species.

1934 Sato, T. 1988. **A report of field experiences of tree planting in the Philippines**. Tropical Forestry 12: 45-50.

Species planted include *Tectona grandis*.

1935 Schaeffer. 1914. **Teak cultivation in Java**. International Institute of Agriculture Monthly Bulletin 3.

1936 Schwartz, P.B; Madzlan Hj. Ahmad; Ho, C.P. 1976. **Notes on an experimental introduction of teak (*Tectona grandis*) into Sarawak, Malaysia**. Planter 52(609): 459-466.

1937 Seubert, R. 1897. **Observations on teak cultivation in Dutch East Indies**. Allg. Forest-u. Jagdztg 73: p73.

Describes the methods adopted for obtaining natural regeneration of teak in Java and Madura and recommends methods of artificial regeneration of teak.

1938 Seubert, R. 1897. **The cultivation of teak in the Dutch Netherlands**. Indian Forester 23(b): 195-201.

Describes the methods adopted for obtaining natural regeneration of teak in Java and Madura and recommends methods of artificial regeneration of teak.

1939 Sharma, S.K. 1979. **Enrichment of tropical moist deciduous forests by planting in Andaman Islands**. Indian Forester 105(4): 260-273.

The history of enrichment planting in the islands is briefly reviewed. Teak is the main species used. The methods used for planting are described. Growth data are presented for enrichment plantings of teak in regeneration areas.

1940 Sieverts, A. 1956. **The cultivation of teak in Java**. IUFRO, 12th Congress, Oxford, 1956 IUFRO/56/22/12: 2p.

Briefly describes a successful method of regeneration by direct sowing in contour trenches with a cover crop of *Leucaena glauca* between the rows.

1941 Simatupang, M.H. 2000. **Some notes on the origin and establishment of teak forest (*Tectona grandis* Linn.f.) in Java, Indonesia**. Potentials and opportunities in marketing and trade of plantation teak: Challenge for the new millenium. Proceedings of 3rd Regional Seminar on Teak, Indonesia, 31 July-4 August 2000: 91-98.

1942 Singh, J. 1994. **Biodiversity afforestation model. An approach**. Indian Forester 120(9): 860-867.

Systematic efforts have been made to integrate the concept of biodiversity into an afforestation programme in East Melghat Forest Division, Maharashtra. The choice of species was based on the species composition of the natural forests of the area, modified to take account of various management considerations. The methodology used is described, including nursery aspects and planting design. Each unit is planted with 1250 teak plants and 1250 mixed species. A detailed model layout is given which is composed of subunits of different species composition.

1943 Smythies, E.A. 1930. **The introduction of teak in the United Provinces**. Indian Forester 56(9): 371-376; 57, 1931: p44.

During the last ten years large scale teak planting started in various divisions of United Provinces. The method of planting and rate of growth is indicated and the problem of pure teak plantations is discussed. The policy of future teak introduction in United Provinces is outlined.

1944 Soerianegara, I; Mansuri. 1994. **Factors which determine the success of regreening in Gunung Kidul, Central Java**. Workshop on the rehabilitation of degraded tropical forest lands, November 1991, University of Queensland, Brisbane, Australia. Journal of Tropical Forest Science 7(1): 64-75.

This investigation was carried out in villages participating in the regreening programme in Yogyakarta Province, Central Java. Species used in the regreening programme include *Tectona grandis*. The highest percentage of success of 54.6 percent was reached by *Tectona grandis*. The species most preferred by the villagers were *Tectona grandis* and *Acacia auriculiformis* .

1945 Soesilotomo, P.S; Soenarya, Y. 1991. **Planning of enrichment programme in Bojonegoro Forest District**. Duta Rimba 18(137/138): 7-14.

For teak plantations in Java.

1946 Somarriba, E; Beer, J; Morataya, R; Calvo, G. 1999. **Line planting of *Tectona grandis* Linn.f. in the humid tropics of Costa Rica and Panama**. (Spanish). Revista Forestal Centroamericana 28: 15-21.

The effects of site characteristics on survival, growth and financial gain with line planting of teak established in Talamanca, Costa Rica and Changuinola, Panama were analysed. Teak performed best on well drained alluvial soils, with a water table below 50 cm and with early natural regrowth. It grew well on sandy soils under laid with coral. Timber production from teak line planting is found very attractive.

1947 Srivastava, A.K. 2000. **An experience with irrigated teak plantation at sanghinagar in India**. Bio technology applications for reforestation and biodiversity conservation. Proceedings of the 8th International Workshop of BIO REFOR, Kathmandu, Nepal, 28 November-2 December 1999: 31-33. M.S. Bista; R.B. Joshi; S.M. Amatya; A.V. Parajuli; M.K. Adhikari; H.K. Saiju; R. Thakur; K. Suzuki; K. Ishii, Eds. BIO REFOR, Ministry of Forests and Soil Conservation, Kathmandu, Nepal.

The site was earlier partly agricultural land and partly fallow. The site condition is very poor with murram type soil and low under ground water table and having low rainfall around 700 mm. The irrigation and general silvicultural techniques of the plantations are described.

1948 Srivastava, P. 1994. **Present status of reforestation in PNG: Research needs**. JIRCAS International Symposium Series, Japan, March, 1994, No.1: 120-130.

About 42,000 ha of plantations have been raised of which include teak. The paper reviews the present status of reforestation, constraints and problems leading to the priorities of research for the management of logged-over forests including the rehabilitation of degraded areas.

1949 State Agricultural University, Wageningen. 1973. **Afforestation of eroded soils in Java (Indonesia)**. 64p. State Agricultural University, Wageningen, Netherlands.

The site requirements of seventy five tree species are listed and indications are given of those which are suitable for afforestation in the study area. Those recommended for the main reforestation areas include *Tectona grandis*.

1950 Subramaniam, B.A. 1956. **Teak plantations in the Andamans**. Indian Forester 82(4): 190-194.

Gives a short account of the history and growth data of the plantations. It is indicated that teak will grow well in the Andamans.

1951 Swaminath, M.H. 1992. **Advances in afforestation technology**. 320p. Prabha Publishing, Jayanagar.

Principles and practices for afforestation in India are presented. Chapters are on individual species/families, seeds, nursery, land preparation, time of planting, field conditions and planting operations, nutrient management in plantations, soil working and intercultivation - i.e. periodic cultivation within plantations, pest and disease management, soil and moisture conservation, coppicing, thinning and pruning, protection, agroforestry - including the use of plantation crops, farm forestry, social forestry and intercropping, methods of vegetative propagation of different species including *Tectona grandis*. Information on seed collection and nursery techniques for some important forest species is appended and a short bibliography is included.

1952 Taggarse, P.M. 1945. **My impressions on the general principles of teak plantation**. Indian Forester 71(9): 303-304.

The author is of the opinion that the growth of a teak plantation after the first ten years depends mainly on the nature of the subsoil and the level of the water table, deterioration of the soil is bound to result in one rotation of teak and is avoidable only by growing another species in the second rotation, exposure owing to clear felling results in soil erosion, defoliation cannot be controlled by leaving broad strips of natural forest between plantations, the formation of heartwood is slower in plantations than in natural forest and if it starts early its future is unpromising, epicormics are caused by hard subsoil and their growth is stimulated by opening-up, the main problem of teak plantations is that of revenue and expenditure.

1953 Tariel, J. 1966. **Teak in the Ivory Coast**. (French). Bois et Forests des Tropiques 107: 27-47.

Outlines the soils and climate of the region, the system of establishing plantations in the Bakoue region and examines problems involved.

1954 Thyagarajan, M. 1959. **Teak planting along fringes of water-course in Delta areas**. Proceedings of All-India Teak Study Tour and Symposium, December 1957-January 1958, Dehra Dun: p188.

Describes teak planting techniques, along the fringes of lakes, rivers and canals in Madras state.

1955 Tjau, I.K. 1953. **Mechanical ploughing in the forest division of S. Banjuwangi**. (Javanese). Rimba Indonesia 2(8/9): 346-348.

Dealt with the successful experimental ploughing of *Imperata cylindrica* done in the teak forest and afforested with teak.

1956 Vaclav, E; Skoupy, J. 1972. **Growing of teak (*Tectona grandis* Linn.f.) in Bangladesh**. Silvaecultura Tropica et Subtropica 2: 11-28.

Traces the history of experience with teak since its introduction in 1871. It is introduced from Burma. Discussed with the climate and soils, forest communities, seed production and pre-treatment, sowing, planting methods, establishment of plantations, tending, pests and damage by cyclones.

1957 Wepf, W. 1954. **Teak cultivation in Java**. (Dutch; Javanese). Rimba Indonesia 3(8/10): 378-416.

Discusses the development of the taungya system, cultivation methods, value of artificial rather than natural regeneration, the need for avoiding competition with other trees, the value of interplanting, chiefly with *Leucaena glauca*, and the treatment of the interplanted crop.

1958 Wilson, P.H. 1987. **The importance of stump size in establishing plantations of *Gmelina arborea* and *Tectona grandis***. Forestry Division, Solomon Islands, Forest Research Note 31-3-87: 9p.

Trials were undertaken to determine the best size of stump planting stock for establishment of vigorous plantations. Four stump size classes based on root collar diameter were tested. The results showed that smaller sizes give the best results.

1959 Wilson, P.H. 1988. **An investigation into planting methods**. Forestry Division, Solomon Islands, Forest Research Note 44-12-88: 6p.

Tested three types of preplanting cultivation - notching, dibbling and pitting - to identify whether survival and early growth were affected. Trials were carried out using stumps for *Tectona grandis*.

1960 Wiroatmodjo, R.S. 1955. **Increasing teak production in Java**. (Javanese). Rimba Indonesia 4(9/12): 378-409.

Certain recommendations are made for increasing the teak production in Java. Planting deforested areas, thinnings based on canopy density, road-building to allow of thinning in areas at present inaccessible, selection felling in the fifth decade to accelerate increment, economical crosscutting, use of appropriate silvicultural systems in areas unsuitable for clear felling, use of the financial rotation and intensive management to improve soil conditions and to allow shorter rotations are the recommendations made.

1961 Wyatt Smith, J. 1957. **A note on teak in northwest Malaya**. Malaysian Forester 20(3): 129-139.

Gives data for the Langkawi plantation established in 1909 with details of climate, soil and nursery and planting techniques. Recommendations include spacings of 12 X 12 or 12 X 16 ft., light alluvial soil, use of stump plants rather than cuttings and of Javan rather than Thailand stock and burning to reduce competition.

1962 Wycherley, P.R. 1962. **Suggestions for further investigations on teak in north-west Malaya**. Malaysian Forester 25(1): 5-14.

There are promising teak plantings in North-West Malaya. It is found that teak can be established as an economic plantation timber crop in the area.

1963 Yamada, H. 2002. **Planting trials at degraded forest lands in the northeast Thailand**. (Japanese). Tropical Forestry 53: 57-65.

The results of the species trials made with different species including *Tectona grandis* are reported.

1964 Zuhaidi, A.Y; Ab Rasip, A.G; Noor Mahat, M; Wahab, M.A; Wickneswari, R; Nik Zanariah, N.H (Eds). 1998. **Commercial cultivation of teak, sentang, Acacia and Hevea for timber: Proceedings of the Seminar, 9 January 1997, Kuala Lumpur**. (English; Malay). 64p. Forest Research Institute Malaysia, Kuala Lumpur.

The following papers on teak cultivation are included 1. Prospects for forest plantation in Malaysia: Potentials and challenges 2. Viability of planting teak and sentang in Malaysia. 3. Commercial cultivation and utilisation of teak and sentang in Thailand. 4. Commercial experience in tree plantation establishment.

1965 Zwart, W. 1911. **Cultivation**. Tectona 4: 35-41.

Go top

Plantation Techniques and Management

(See also 0170, 0190, 0194, 2406, 4648)

1966 **Cutting of bamboo shoots in order to favour teak**. Indian Forester 21, 1895: p265.

Recommends method of cultural operation and cutting bamboo to promote growth of teak.

1967 **Teak plantations in Ceylon, Extract from Ceylon Forester**. Indian Forester 22(2), 1896: 444-446.

Notes from teak plantation experience of Ceylon is given of nursery methods, planting and planting methods including costs.

1968 **A note from the Myodwin teak plantations**. Indian Forester 29(10), 1903: 458-459.

Describes young plantations at Forest Bungalow occupied by Dr. Brandis of early seventies in all vigour and the house and village are in ruins and abandoned with photographs.

1969 **Notes on thinning and sale of thinnings**. Tectona 4, 1911: 434-436.

1970 **Teak plantations**. Indian Forester 48(10), 1922: p561.

The writer argues for wider spacing of 20 to 30 ft. to save labour, weeding convenience and planting larger areas.

1971 **The problem of the pure teak plantation**. Indian Forester 58(12), 1923: 720-721.

Mr. H.G. Champion's article on the subject was reviewed and concludes accurate comparative data are lacking to prove the changes of bad growth, epicormic branching, fall in growth rate, fluting and damage severely by bee-hole borer. The problem of mixtures is discussed and the mistaken past management of Nilambur Teak Plantations in clearing all undergrowth is stressed as main cause of alarm.

1972 **Some notes and problems of the Central Provinces teak areas**. Indian Forester 50(11), 1924: 567-572.

For better yield of teak from natural forests the paper discusses silvicultural and management practices to be followed.

1973 **Comparison of methods of treating teak in India and Dutch East Indies**. Forestl JBER, 1925: p192.

1974 **Thinning teak areas**. Indian Forester 52(3), 1926: p133.

Discusses thinning marking of teak.

1975 **Thinning teak areas**. Indian Forester 53(12), 1927: p743.

Recommends pruning for silvicultural grounds for providing space and reducing competition with left-over stems and comments on marking procedures.

1976 **Burning on areas to be planted with teak**. Indian Forester 58(5), 1932: 288-289.

1977 **The teak plantations of Togoland**. (French). Revue International des Products Colonianx et due material colonial 21(199): p62; Revue Internationale du Bois 13(105), 1946: p71.

Teak was introduced into Togoland in 1901 by the Germans. The French administration has continued to plant teak and there are now more than 4 million trees. The German plantations was a mixed plantation, but the French have planted Teak pure, which greatly facilitates thinning and has not so far caused outbreaks of insects or fungi.

1978 **Effect of planting espacement**. Forest Research in India and Burma, Part II, 1947: p53.

Drawing from Nilambur experiments an espacement of 8.5 x 8.5' was recommended not with standing the tendency of branching which gives better height growth due to wider spacing. The recommendation is based, if pruning is not costly and sawnwood from such espacement grown teak is not weak or defective.

1979 **Comparison of planting teak stumps in prepared pits and crow bar holes**. Forest Research in India and Burma 1948-49 Part II, 1949: p24.

The Central Provinces and Berar experience showed no appreciable differences between the two methods.

1980 **Effect of cost of different methods of weeding in teak plantations**. Forest Research in India and Burma 1948-49 Part II, 1949: p24.

It was observed that the effect of ploughing between the lines was very marked in preventing heavy growth of grass.

1981 **Thinning research in teak**. Forest Research in India and Burma 1948-49 Part II, 1949: p36.

Comparison of three grades of thinning carried out in Nilambur of 15 years old was discussed in the light of prescriptions of All India yield tables.

1982 **Pruning teak plantations**. Forest Research in India and Burma 1948-49 Part II, 1949: p36.

Madras experiments indicate feasibility of this operation to produce cleaner boles.

1983 **Teak: Dr. Craib's theory of thinnings in Nilambur - Results**. Extract of note from provincial Silviculturist (Mr. K.N.R. Nair to C.C.F. in Rc. 291/50 dt. 25-2-1950), 1950.

Gives a detailed note and discussion of results of applying Craib's theory of thinnings in Nilambur plantations.

1984 **Teak**. Forest Research in India Part II (1951-52), 1952: p113.

It is suggested that in areas with over 60" annual rainfall, wider espacement is safe and good.

1985 **Experimental plantations**. Forest Research in India Part II (1952-53), 1953: p4.

Storage experiments on teak stumps before planting with one week, two weeks and control tried in a 4 x 4 Latin Square design - indicated stumps without storage gave best results and 2 to 3 weeks storage worst results both in respect of survival and height growth.

1986 **Teak silviculture tested in two sites**. (English; Spanish). Caribbean Forester 14(1/2), 1953: 27-28; 59.

A report on plantations of *Tectona grandis* established on good sites in Puerto Rico.

1987 **Teak plantations by Coorg method**. Forest Research in India Part II (1952-53), 1953: p75.

Comparison of burning teak plants and cutting back in first year with control gave better survival and height growth for control and more uniform growth in burnt plots.

1988 **Experiment on burning grass and cutting back teak in areas covered with patches of grass in Tithimatti range**. Forest Research in India Part II 1953-54, 1954: 35-36.

Burning of grass in Thithimatti range has in no way helped the teak plants to put on better growth.

1989 **Garden experiment to determine the best period of planting teak and other species in Coorg**. Forest Research in India Part II 1953-54, 1954: 33-34.

Planting teak and other species in third week of May give best percentage of success followed by June first week planting.

1990 **Tending, thinning, climber and weeds**. Forest Research in India Part II 1954-55, 1955: p78.

Pruning in teak plantation does not appear to be beneficial.

1991 **Teak experiments on espacement**. Forest Research in India Part II 1954-55, 1955: p73.

Of the two espacements 6'x 6' and 8.5'x 8.5' it was observed that wider espacement give better height growth and planting and weeding costs is cheaper by 22 percent hence the same was adopted for 1951 onwards in Nilambur and Kannoth plantations.

1992 **Teak plantations-Wynaad-best intensity of thinning**. Forest Research in India Part II 1954-55, 1955: 78-79.

It is reported that different intensities of thinnings have no effect on height growth. Heavier grades of thinnings give progressively higher diameter increments. At the end of 16 years the yield of useful basal area decreases as the intensity of thinning increases and at the end of 16 years, the yield of total volume produced to date, decreases as intensity of thinning increases.

1993 **Teak plantations-heavy and early thinnings to anticipate and not to follow likely suppression**. Forest Research in India Part II 1954-55, 1955: p79.

It was found that heavy thinning to anticipate and not follow like suppression yields rapid diameter increment, but the total volume production is greater with an ordinary D-grade thinning as adopted in district practice.

1994 **Teak plantations: Wynaad-experiments to ascertain the best time for first thinning**. Forest Research in India Part II 1954-55, 1955: p78.

First thinning at the age of five years yields greater diameter in 21 years than first thinning at the age of 7 years or 9 years.

1995 **Records of forest plantation growth in Mexico, the West Indies and Central and South-America**. Caribbean Forester 21, 1960 .

Detailed accounts of area, number of stems per ha., age at present, and d.b.h. at various ages, locality factors like elevation, rainfall, soils and their pH, origin of seed, planting espacement and methods of planting, stocking, tending, thinning and pruning operations carried out and seed production and flowering are given.

1996 **Energy in the revival of teak**. (Thai; English). Vanasarn 21(2), 1963: 101-104.

Reports on revival of shoots from 23 cm pole - which sends up 0.92 to 1.06 metres shoots in one to 1.5 years and recommends on proper cutting.

1997 **Seminar on man made forest in Indonesia, 1970**. Laporan 100-102, 1969: 16-36.

Out of the three papers presented one paper was on the function of forest tree improvement in the development of industrial forests which recommends breeding programmes for *Tectona grandis*, *Pinus merkusii* and *Agathis loranthifolia*.

1998 **Silvicultural and economic studies for industrial reforestation in Panama**. (Spanish). 14p. Colegio de Ingenieros Forestales, Obarrio, Panama, 1990.

A general account of reforestation in Panama, covering trials, land availability, replanting costs, economic analysis, operations in plantation establishment and management, ecological zones, yields for the species including *Tectona grandis*, suitable sites and the urgent need for reforestation. The resources available for reforestation are discussed.

1999 **The forgotten forest**. Holz Zentralblatt 117(8), 1991: 126-127.

Benin discovers its timber as economic resource. Sustained management of teak plantations intended.

2000 Abayomi, J.O; Ekeke, B.A; Nwaigbo, L.C. 1985. **Some preliminary results of teak thinning trials in Nigeria**. Proceedings of the 15th Annual Conference of the Forestry Association of Nigeria, Yola, 25-29 November 1985: 290-299. J.A. Okojie; O.O. Okoro, Eds. Forestry Association of Nigeria, Nigeria.

Results are reported of analyses of variance of diameter increment and height increment of twelve teak thinning trials at six sites. Diameter increment tended to increase with thinning intensity, while height increment and basal area were less affected by thinning treatment.

2001 Abegbeihn, J.O. 1982. **Preliminary results of the effects of spacings on the growth and yield of *Tectona grandis* Linn.f.** Indian Forester 108(6): 423-430.

Measurements of g.b.h., height and volume were made of a 7-yr-old plantation raised at Nimbia, Nigeria in different spacing. It is found that spacing affect mean diameter and basal area but not mean and top height, form factor and total volume.

2002 Adekunle, A.O. 1964. **A conversion system for the management of coppiced teak plantations**. The role of forestry in the economic development of the savanna areas of Nigeria. Proceedings of the first Nigerian Forestry Conference, Kaduna, 1964: 189p.

2003 Adiody, P.N. 1959. **Recent trends in thinning of teak plantations in Nilambur**. All India Teak Study Tour and Symposium, December 1957-January 1958, Dehra Dun: 190p.

Gives experiments in thinning teak plantations and state experience in the matter.

2004 Ahmad, Y.S. 1935. **The Bamonpokri teak plantations**. Indian Forester 61(12): 786-790.

Describes the locality factors and tract, traces the history of teak plantations in this area. The method of raising the plantations is discussed with costs.

2005 Aleem, S.A. 1967. **Teak as a plantation species in Pakistan**. IV Teak Sub-Commission, FAO, Rome: 3p.

The climatic conditions for the growth of teak, past history, age, distribution of existing plantations, their technique and other characteristics are discussed and labour supply problems are outlined.

2006 Allsop, F. 1940. **Kyetpyugan teak plantation, Insein Forest Division, Burma**. Empire Forestry Journal 19: 43-47.

The Kyetpyugan teak plantations were started with a view to producing concentrated stocks of teak timber for export. But the site was ill-chosen and capable only of producing inferior quality of teak suitable only for local supply.

2007 Altona, T. 1922. **Djati en Hindoes. Oorsprong van het Djatibosch in Bodjonegeno Java**. (Indonesian; English). Tectona 15: 457-507.

Regular espacement of teak forests suggests of plantation origin attributed to Hindoo period of 14th to 16th century. Teak mixed with *Butea monosperma* and *Schleichera oleosa*, linguistic origin of the names, absence of mixed teak forests, presence of local Hindoo population and planting distance of 12-32 hastas all confirm this supposition.

2008 Altona, T. 1923. **Teak and Hindoos**. Tectona 16: 556-560.

Many teak forest in Java has been proved to be old plantations and could not be proved to have been planted. These old forests were planted by Hindoos. The frequency of old teak plantations and the absence of virgin forests make it very improbable that the teak tree is native.

2009 Appelman, F.J. 1926. **Crop rotation as a necessity in teak cultivation**. (Indonesian; English). Tectona 19: 835-842.

The author recommends crop rotation in soils lower in quality, which deteriorate under pure, poorly growing teak plantations-which may be alternated with crops of *Crotoleria* spp.

2010 Asa Prombubpa. 1974. **Study on the effect of different intensities of thinning on the increment of teak**. (Thai). Faculty of Forestry, Kasetsart University, Thailand, Research Note 9: 12p.

A study was made of the effects of thinning in *Tectona grandis* plantations in Lampang province, Thailand, removing 50, 60, 70 and 80 percent of the original basal area. The optimum intensity of thinning was taken as 50-60 percent.

2011 Aweto, A.O. 1990. **Plantation forestry and forest conservation in Nigeria**. Environmentalist 10(2): 127-134.

Shifting cultivation and logging are discussed as the main causes of forest depletion. The Nigerian government's response to rapid forest depletion has been to establish tree plantations, mainly of fast-growing exotics such as teak and *Gmelina arborea*.

2012 Bambang, A.S. 1981. **Thinning principles in teak forests**. (Indonesian; English). Duta Rimba 7(46): p3.

2013 Banjibhatana, D. 1959. **Silvicultural research and management of teak in Thailand**. Royal Forest Department, Bangkok.

The silvicultural research programme on teak and other tree species in Thailand were studied.

2014 Barnard, R.C. 1953. **Experience with exotic tree species in Malaya**. Malaysian Forester 16(1): 29-40.

Includes notes on nursery and plantation experience with different species including *Tectona grandis*.

2015 Barrott, H.N. 1968. **The Nimbia timber plantation project: Teak**. Bulletin of Nigerian Forest Department.

2016 Becking, J.H. 1941. **The rotation for teak forests in Java**. (Dutch). Tectona 34: 507-514.

The most desirable rotation for teak in state forests has been calculated at 125-135 years for fully stocked stands.

2017 Becking, J.H. 1951. **Forestry technique in the teak forests of Java**. Proceedings of UNSCCUR, Lake Success 5: 106-114.

2018 Beekman, H. 1917. **Thinning and clearing of teak**. (Indonesian; English). Tectona 10: 685-694.

2019 Beekman, H. 1917. **Rotation for teak forests of Java treated under the clear cutting system**. Tectona 10: 995-1044.

2020 Beekman, H. 1918. **The correct rotation for teak stands**. (Indonesian; English). Meded Proefsta Boschw 13: 72-74.

Determination of correct rotation for planted teak and remaining natural teak forests is stressed. The financial, maximum volume of production and technical rotation are discussed and their inter-relationships are indicated. Corde's volume rotation of +/- 70 years is examined and the various methods of calculating financial/technical rotation are stressed and compared with British India.

2021 Beekman, H. 1936. **Rotation of teak plantations**. Tectona 29(2/3): 108-136.

Based on data available at FRI, Buitenzorg, the Bruce (1920) and Wulfing (1932) methods of preparing volume tables are questioned and concludes that 1920 data has no influence upon fixing financial rotation. The decrease in growth rate upto a certain age is counter-balanced by an increase in the ratio of marketable timber to the total product.

2022 Beekman, H.A.J.M. 1949. **Silviculture in Indonesia**. (Dutch). Publicatie van de Stichting `Fonds Landbouw Exportbureau 1916-1918', Wageningen 33: 386p.

Other than general papers, a series of comprehensive summaries of the available information on the biology and silviculture of four important species including *Tectona grandis* is included.

2023 Bellouard, P. 1952 . **Report on the French West Africa Federation**. (French). Proceedings of the 1st Conference of Forestry Inter African Countries, Abidjan, 1951: 33-120 .

Describes methods and results in close planting, enrichment by strips and natural regeneration, covers artificial regeneration of the savannas with indigenous and exotic spp. including teak.

2024 Betts, T.F. 1941. **The Tiv plantations - 1939 to 1941**. Farm and Forest 2: 110-113.

Plantation work was confined to the establishment of *Gmelina arborea* and teak on favorable sites and the protection and treatment of certain areas to improve conditions for the natural regrowth of woody vegetation. Encouragement was given to the planting on household surrounds.

2025 Beumee, J.G.B. 1918. **Development of young teak planted in Trinidad**. Tectona 11: 243-244.

2026 Beumee, J.G.B. 1922. **Results of the remeasuring of 40 permanent sample plots reserved for the investigations regarding thinning and yield of teak plantations**. (Indonesian; English). Tectona 15: 76p.

Results show that heavy thinning in suppressed forests of good or better quality increases volume of standing timber than low light thinning due to higher rate of growth of diameter but not height, in vigorous growing forests slight thinning impairs the development of large trees, slight thinning of dominant trees has same influence as heavy thinning of suppressed trees, thinning of dominant tree lightly results in freeing the crowns and increased volume of production by best formed trees, heavy thinning of dominant trees produces increased diameter growth, heavy partial clearance stimulates diameter growth at breast height.

2027 Billah, A.H.M.M. 2003. **Optimal rotation of teak production: Tools for economic analysis**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

An attempt is made to determine the optimal rotation of teak plantation in order to make management efficient and long term investment financially remunerative and attractive. It is found that ideal rotation for teak plantations would be 20-21 years. It is recommended for further research to arrive more realistic and accurate estimate of rotation for appropriate management and felling policy prescriptions.

2028 Blanford, H.R. 1923. **Spacing in teak plantations**. Indian Forester 49(1): 50-53.

Out of various spacings tried found 6'x6' espacement as ideal and wider or closer spacings as not very economical.

2029 Blanford, H.R. 1923. **Thinning in teak plantations**. Burma Forest Bulletin 9 (Silviculture Series 8): 6p.

Deals with first, second and subsequent thinnings and cleanings and suggestions are made on season and year at which thinnings should be carried out. Average spacing and number of stems per acre at different ages for past thinned and unthinned plantations are given.

2030 Blanford, H.R. 1923. **The effect of wide spacing in teak plantations**. Indian Forester 49(6): 301-303.

Compared the increment of two teak plantations of 9x9 ft. and 6x6 ft. espacement. The author comments on forking, height growth, etc. and concludes that tendency with forking with wider spacement counteracts the slight increase in diameter increment.

2031 Blanford, H.R. 1933. **Some Burma notes on the problem of pure teak plantations**. Forest Bulletin 78 [Indian Forester 59(7): 455-461].

Discusses fluted boles, epicormic shoots, defoliation, soil deterioration and erosion attributed to pure teak plantations. Their causes are mainly due to mistakes in past management are examined in detail and remedies suggested.

2032 Bohidar, N. 1951. **Thinning research in teak**. Madras Forest College Magazine 27(3): 140-147.

The paper describes the history of preparing yield tables of teak and subsequent research on thinning teak crops.

2033 Boonsomboon, P. 1965. **Comparison of survival percentage and growth of teak stumps of three years after planting with different kinds of stumps**. (Thailand). Student Thesis. Kasetsart University, Bangkok.

Teak stumps with root and without root have not given different height growths and survival is 89 and 87 percent respectively. Survival of stumps stored for one week (90 percent), two weeks (95 percent), three weeks (72.5 percent), four weeks (62.5 percent) and control (95 percent).

2034 Bose, R.K. 1909. **The best season for coppicing teak**. Indian Forester 35(12): 683-684.

Describes results of different seasons for coppicing in Indore forests. May coppicing appears best season with 3-4 vigorous coppice shoots per stool.

2035 Brascamp, E.H.B. 1914. **A visit to the Rembrangsche teak forest by J.B. Teysman in 1854**. (Indonesian; English). Tectona 7: 457-458.

2036 Brascamp, E.H.B. 1915. **Concurrence for teak thinning knife**. Tectona 8: p563.

2037 Brascamp, E.H.B. 1917. **Memoirs of an old member of the administration of wood forestry Mr. Daendels, quarter of a century later about the management of teak forests**. (Indonesian; English). Tectona 10: 586-590.

2038 Brascamp, E.H.B. 1917. **The teak forests: Memoirs of Mr. William Hendrik van Ostenberch, Gouverneur in Java in 1765: No.VI in Kolonial Archief**. (Indonesian). Tectona 10: 1045-1055.

2039 Brascamp, E.H.B. 1920. **Travels from Japara to D. Van Den Straten over Rembang and Blora near Pamolan to visit the teak forests**. (Indonesian; English). Tectona 13: 329-335.

2040 Briscoe, C.B; Nobles, R.W. 1966. **Effects of pruning teak**. Inst. Trop. For., Rio Piedras, U.S. For. Serv. Research Note ITF 11: 6p.

Results of the study on the incidence of adventitious branching, after pruning of 8- to 10-year *Tectona grandis* plantations at St. Croix, Virgin Islands are presented.

2041 Briscoe, C.B; Ybarra Coronado, R. 1971. **Increasing growth of established teak**. Institute of Tropical Forestry, United States Forest Service Research Note ITF-13: 7p [Commonwealth Forestry Review 51(4), 1972: 290-294].

Teak plantations in Puerto Rico, 3-16 years old, were thinned and fertilized. Removal of competitors is found to be the best method for increasing the rate of tree increment. Height growth was greater in the areas with higher rainfall. Both height and basal area growth were greater on the andesite-derived alluvial sites than on the residual soils over limestone. Basal area increment was positively correlated with total height growth with K.

2042 Brooks, R.L. 1941. **Notes on pure teak plantations in Trinidad**. Caribbean Forester 3: 25-28.

Pure Teak plantations in Trinidad were started in 1913 and are expanded at the rate of about 400 acres per annum, with a present total area of 2,100 acres . A list is given of standard practices adopted by a recent conference of technical officers.

2043 Brunck, F. 1972. **The use of weed-killers in tropical forest nurseries and plantations**. Bois et Forests Des Tropiques 141: 31-39.

Briefly reviewed the types of nursery and plantation work that involve the use of weed-killers.

2044 Bryant, C.L. 1968. **The effect of weed control on the growth of young teak in Tanzania**. Silviculture Section Forestry Division, Lushoto, Silviculture Research Note 8: 2p.

Trials of five weeding treatments showed that clean weeding of *Tectona grandis* planted on a rain-forest site in E. Usambara, increased first-year height by 57 percent vs. partial weeding and survival was also better.

2045 Budiantho, D. 1989 . **Influence of wider spacing of teak on mean diameter and space available for food crops in the taungya system**. (Indonesian). Buletin Penelitian Hutan 516: 13-26.

The results are reported of a study on teak spacing in Saradan Forest District, East Java. Greater distances between plants in the same row resulted in greater diameter growth of the stand, while wider distances between rows gave a larger intercropping area.

2046 Butterwick, A.J. 1932. **Early records of stump transplanting**. Indian Forester 58(11): 645-646.

The earliest mention is traced 1920 (Champion and Plant), while the author reports the use of the method mentioned in 1896 acc. to Bulletin No. 5, Agricultural Series, Department of Lands and Agriculture, N.W.P. Oudh under the head 'A new method of planting' practised about 8 years ago was described as useful for deciduous trees like teak and pyinkado, and thus the date of first stump-planting is traced to 1888.

2047 Chacko, K.C. 1998. **Silvicultural problems in management of teak plantations**. Teak for the Future: Proceedings of the Second Regional Seminar on Teak, Yangon, Myanmar, May 1995: 91-98.

Performance of plantations under high input management remains under investigated. The paper attempts to discuss various issues involved in teak plantation management and suggests alternatives for ensuring quality.

2048 Champion, H.G. 1932. **The problem of the pure teak plantations.** Indian Forest Bulletin 78.

The problems and advantages of mixed plantings was discussed, frequent and heavy thinnings were recommended for teak as this will be good both as soil cover and also contributes to increased productivity. Fire protection is recommended. From economic point of view - pure teak is considered as a viable and profitable proposition.

2049 Chaturvedi, J.K. 1961. **Coppice with reserve system**. Proceedings of the 10th Silvicultural Conference: 944-950. Forest Research Institute, Dehra Dun.

The distinctive features of the silvicultural system as applied in the management of dry deciduous forests of central India containing teak and other coppiceable species are discussed. This system in addition to meeting local, agricultural and small timber demands, preserves locality factors and improves the general quality and extent of growing stock.

2050 Chuasawan, W. 1985. **Plantation establishment methods and techniques in Thailand**. Proceedings, Workshop on nursery and plantation practices in the ASEAN, Jakarta, 3-7 October 1983: 239-258; 293-294. New Zealand Forest Service, Wellington, New Zealand.

Descriptions are given of nursery and plantation establishment techniques in general and for selected species for large-scale plantation establishment including *Tectona grandis*.

2051 Classen, J.C van R. 1915. **Answer to Mr. Soeters article "Rotation of teak forests, Tectona, July 1951"**. (Indonesian; English). Tectona 8: 848-853.

A general article in reply to Mr. Seeters comments on rotation of teak forests.

2052 Clifford, J.D. 1919. **The effects of thinnings on a young teak plantation**. Indian Forester 45(1): 16-18.

Thinning is considered beneficial to young teak plantation. In a 17 year old teak plantation in Pyinmana Division, Burma the above conclusion is arrived after a study of girth increment.

2053 Coster, C. 1932. **The burning out of plantation areas in the teak forests**. Tectona 25(2): 71-95.

A short discussion of theoretical advantages and disadvantages on burning vegetable waste in tropical soils to be planted with teak is given. Middle Java experiments by interplanting teak between rows of old stumps were described. Growth of teak was better under method.

2054 Danhof, G.N. 1941. **Business rotation of teak**. (Dutch). Tectona 34: 779-809.

It is reported that in teak forests in the Dutch Fast Indies, the rotation of the highest financial yield is only slightly more profitable than that of the highest income.

2055 Danhof, G.N. 1941. **Commercial rotation of the teak**. (Dutch). Tectona 34(10): 779-809.

It is reported that in the Dutch-East Indies, the rotation of the highest financial yield is only slightly more profitable than that of the highest income.

2056 Dembner, S.A; Perlis, A (Eds). 2000. **Teak - Special issue**. Unasylva 51(201): 65p.

Eight papers are included on various aspects of teak silviculture and management worldwide. A paper discusses the utilization of rubber wood as a substitute for teak in high-value products.

2057 Deventer, A.J van. 1913. **Note on the rotation time and regulation of trade in the teak forests of Java**. (Dutch; English). Tectona 6: 608-626.

2058 Dhareshwar, S.S. 1940. **Honavar range and teak regeneration. Part II**. Indian Forester 66: 345-349.

Yield statistics from a test plot appear to confirm the view expressed in a former article that 9 ft. X 9 ft. is the best spacing for teak in the Honavar range.

2059 Doorn, Z van. 1931. **Quality management of teak as a guiding principle for the treatment of stands**. Tectona 24: 984-987.

2060 Doorn, Z van. 1933. **Free rotation classes for regulating the operation of teak forests**. Tectona 26: 1-25; 352-358; 388-390; 551-557.

A reply is given by author for the debate on the topic.

2061 Doorn, Z van. 1936. **Considerations affecting the rotation in the teak forests of Java**. (Dutch). Tectona 29(1): 1-43.

2062 Drees, E.M. 1941. **An example of improvement in a teak stand through replanting**. (Dutch; English). Tectona 34(10): 772-774.

2063 Dupuy, B. 1992. **Plantations for timber production in dense rain forests of Africa**. Bois et Forests des Tropiques 231: 7-15.

A brief account is given of recent silvicultural techniques used in the establishment of tree plantations in tropical forests. The possible choice of species is outlined. Older plantations tended to be of indigenous, valuable species such as *Tectona grandis*.

2064 Edie A.G. 1916. **Thinnings of teak coppice in the Pole areas of Kanara**. Indian Forester 43(3): 157-159.

Describes experiments on the effect of thinning out of inferior coppice shoots on the growth stimulation in teak on the remaining shoots. Volume increment of thinned shoots is greater than unthinned ones. Recommends thinning after ten years.

2065 FAO. 1967. **Teak as an exotic plantation species in Burma**. FAO Asia Pacific and African Forestry Commission, Fourth Session, Rome FAO: T-67/4: 8p.

Outside natural range teak was planted in 2256 ac. in western and southern regions of Burma. Oldest teak plantations are over 100 years old. Climate, soil and natural regeneration are described. Details of establishment, tending and thinning techniques are given.

2066 Ferlin, G. 1970. **Memories of the Sudan**. (French). Bois et Forests des Tropiques 133: 3-15.

Gives a short illustrated account of forest management and silviculture in the Central Circle, Equatoria Division is given. Problems and techniques of afforestation with trees including teak are described.

2067 Forest Department, Andhra Pradesh. 1973. **Research Report of Silviculturist, Andhra Pradesh Forest Department for the years 1970-71 and 1971-72**. Andhra Pradesh Forest Department, Hyderabad: 1-56.

Teak experiments include grading of teak seed, use of pre-germinated seeds, different soil working intensities and nursery trials of different provenance seeds and fertilizer trials.

2068 Forest Department, Central Provinces and Nagpur. 1941. **Silviculturist's report March 1941**. Forest Department, Central Provinces and Nagpur: 71p. Government Printing Press, Central Provinces and Berar.

In planting with teak original high forest was clearfelled and slash burnt before planting. In well burnt slash patches growth of teak was vigorous.

2069 Forest Department, Madras. 1942. **On stump planting and control of branching and pruning in young teak plantations**. Annual Report on Silvicultural Research in the Madras Presidency for the year 1940-41: p38; 27; 84; 29.

Experiments in the stump planting of teak show that early stump planting is advantageous and that planting the stumps with the top 1 in shoot flush with the ground is beneficial both as regards survival and height growth.

2070 Forest Department, Sri Lanka. 1953. **Eradication of Illuk (*Imperata cylindrica*) in teak plantations**. Report of Conservation Forest, Ceylon 1953, Part 2, 1954: 26-27. Forest Department, Sri Lanka.

Successful experiments for eradication of *Imperata cylindrica* have been made by cultivating plantations. Cultivation is followed by sowing of *Tephrosia candida*. The establishment of this leguminous cover keeps out the Illuk. Result of the operation was the appearance of teak regeneration throughout the cultivated area.

2071 Forest Department, Sudan. 1954. **Weeding and planting methods for *Tectona grandis***. Report of Forest Department, Sudan 1952/53: 39-41 .

An experiment was laid out to investigate intensity of weeding, date of planting and type of plants in the establishment of plantations. Teak planted in June gave significantly better results than that planted in July or August. Weeded plots gave higher survival and better growth.

2072 Forest Department, Tamil Nadu. 1950. **Thinnings (teak) modified thinning cycle for Wyanaad Division**. Extract of Provincial Silviculturist, Ooty, Madras note Re. 1787 949 dt. 27-2-1950.

Mainly deals with thinnings in plantations of Wyanad division.

2073 Forest Research Institute, Dehra Dun. 1929. **The problem of pure teak plantation**. Proceedings of the 3rd Silvicultural Conference, Dehra Dun: p79.

2074 Forest Research Institute, Dehra Dun. 1934. **Problem of the pure teak plantation**. Proceedings of the 4th Silvicultural Conference, Dehra Dun: 126-136.

2075 Forest Research Institute, Dehra Dun. 1939. **A note on the teak plantation technique**. Proceedings of the 5th Silvicultural Conference, Dehra Dun.

Resolved to collect all available information on artificial regeneration and tending of teak.

2076 Forest Research Institute, Dehra Dun. 1967. **Thinning research**. Proceedings of the 11th Silvicultural Conference, Forest Research Institute, Dehra Dun: p615.

A series of comparative thinning trials based on correlated curve trend and other methods be laid out for species of economic importance including *Tectona grandis*.

2077 Forest Research Institute, Dehra Dun. 1983. **Thinnings**. Proceedings of the 11th Silvicultural Conference, Dehra Dun, 15-25 May 1983, Volume III: 1-16. Forest Research Institute & Colleges, Dehra Dun.

Four papers on thinnings in forest crops are included. Note on thinning in coppice crop of teak by Patel, R.I; Thinning by Partap Singh; Quantitative concept of thinning by Suri, S.K; Some results of preliminary trials carried out to test the method of thinning based on the concept of free crown space as compared to conventional classification of stems for thinning forest crops by Madan Mohan Singh.

2078 Foulkes, F. 1914. **Teak in Wynaad II: A study**. Indian Forester 40(6): 241-263.

In Wyanad, North Malabar, where free seedling reproduction is absent, the tree reproduces from coppice shoots and more from root suckers.

2079 Galloway, G; Ugalde Arias, L.A; Vasquez, W. 2001. **Importance of density reductions in tropical plantations: Experiences in Central America**. Forests, Trees and Livelihoods 11(3): 217-232.

Quantitative tree characteristics including live crown ratios, foliage biomass, height-diameter ratios and annual diameter and height increments are useful indicators of tree and stand vigour. Practical approaches to thinning are described for plantations of species including *Tectona grandis* in Central America.

2080 Garland, E.A. 1934. **Technique of teak plantation work**. Proceedings of 4th Silviculture Conference, Dehra Dun, 1934: p297.

2081 Gera, M; Gera, N; Singh, V.K. 2000 . **Rooting response of root cuttings of some MPT species under low cost mist conditions**. Indian Forester 126(2): 171-174.

A rooting trial was carried out using root cuttings of seven multipurpose tree species including teak in a low-cost mist chamber designed and developed at the Tropical Forest Research Institute, Jabalpur. *Tectona grandis* gave a very poor rooting response of 10.0 percent. The findings highlight the importance of vegetative propagation through root cuttings and its substantial scope in tree improvement programmes.

2082 Ghosh, R.C. 1965. **Teak plantations of North Bengal**. Indian Forester 91(2): 83-92.

Sketches the history of these plantations of 4500 ha., and gives climatic and increment data for a number of sites. It is reported that the experience gained during the past 100 years justifies further planting of teak.

2083 Ghosh, R.C; Singh, S.P. 1981. **Trends in rotation**. Indian Forester 107(6): 336-347.

The general trend towards shorter forest rotations in response to growing timber needs and the ability to utilize smaller-diameter timber is discussed. Information is given on rotations currently used for major Indian timber species including teak.

2084 Goot, T van der. 1932. **The elimination of alang-alang (*Imperata cylindrica*) grass in teak plantations**. (Dutch; English). Tectona 25: 792-803.

Author's method of combating *Imperata* grass is useful in regions without a pronounced dry monsoon and on loose soils, but for the teak region in Java it is impractical.

2085 Griffith, A.L. 1938. **An investigation into the relative merits of planting teak (*Tectona grandis*) stumps in pits and in crowbar holes in areas having a West Coast type of climate**. Indian Forest Records 3: 47-59.

The survival percentage and mean height growth shows that planting in pits gives results not different from planting in crowbar holes. The localities in which the experiments were carried out have a climate typical of the West Coast in general and an average annual rainfall varying from 60 to 120 in.

2086 Griffith, A.L. 1938. **An investigation into the best root length of stump to use when stump planting teak (*Tectona grandis*) in areas having a West Coast type of climate**. Indian Forest Records 3: 1-15.

Survival percentage and mean height growth shows that planting in pits gives results not different from planting in crowbar holes. Pitting, being much the more expensive method of preparing the soil for planting, is not therefore economically justified.

2087 Griffith, A.L. 1938. **An investigation into the best date of stump-planting teak at Begur, Dhoni and Topslip**. Indian Forest Records (n.s.), Silviculture 3(2): 46p.

Stump-planting of teak at Begur and Dhoni in the middle of April, 6-7 weeks before the break of the monsoon, gave results far superior to those of normal planting in early June. At Topslip, where pre-monsoon rains are more variable than at Begur and Dhoni, planting had to be delayed until the early part of May to minimize the risk of poor stocking.

2088 Griffith, A.L. 1939. **An investigation into the relative merits and costs of five different weeding methods in the formation of teak (*Tectona grandis*) plantations in areas having a West Coast type of climate**. Indian Forest Records (n.s.) Silviculture 4: 97-132.

Four large-scale experiments covering approximately two acres each show that of the five methods tried, weeding by scraping in 4 ft. strips is the method which gives the most beneficial results at the most reasonable cost. The weed conditions of the experiments are described in the paper.

2089 Griffith, A.L. 1939. **Investigation into the best age and diameter of stump to use when stump planting teak (*Tectona grandis*) in area having a general West Coast type of climate**. Indian Forest Records (n.s.) Silviculture 3(5): 165-194.

The study consisting of seventeen experiments conducted over a period of six years and on four centres shows that use of one or two year old stumps gives best survival and height growth. The limiting size range is put 0.3 to 0.4 inches if the stumps are 2 years old. The saving in cost of a plantation was calculated at Rs. 1.20 per acre due to use of correct size of stumps.

2090 Griffith, A.L. 1942. **Teak plantation technique**. Indian Forest Records (n.s.) Silviculture 5: 123-219.

This is a compilation of all published information on the subject supplemented by answers to a widely circulated and comprehensive questionnaire and other unpublished data available, including his own observations made during extensive tours in India and Burma. The distribution and the climatic and soil requirements of teak are described and the reasons for the general adoption of artificial regeneration reviewed.

2091 Gupta, G.N; Mohan, S; Manivachakam, P. 1986. **Effect of coir peat mulch and fertilizer application on teak establishment in dry zone**. Journal of Tropical Forestry 2(4): 204-210.

Tectona grandis seedlings were grown in plots in the Coimbatore Forest Division treated with 0, 40 or 80 kg/ha N fertilizer as urea, 0, 40 or 80 kg/ha P_2O_5 as superphosphate, with or without peat mulch. Seedling survival, soil temperature and moisture content were recorded. Mulch treatment reduced seedling mortality, increased soil moisture content and slightly reduced soil temperature.

2092 Gupta, M. 1957. **Teak in Uttar Pradesh**. Bulletin of the Uttar Pradesh Forest Department 29: 22p.

Silvicultural characters and techniques are described in detail and research to be undertaken are indicated.

2093 Hart, H.M.J. 1928. **Stem number and thinning - a preliminary study on the bast spacing and thinning method for teak forests**. Dissertation, Wageningen, The Netherlands.

2094 Hellinga, G. 1923. **Natural thinning in unthinned plantations**. (Dutch; English). Tectona 32(4/5): 290-308.

2095 Hellinga, G. 1940. **A renewed investigation on the rotation of teak (*Tectona grandis*)**. (Dutch). Tectona 33: 507-564.

Some 750 sample trees of different diameters were felled and valued according to the timber assortments they yielded. Stand values in relation to age were estimated using the price-size data thus obtained together with previously compiled yield tables and an alignment chart which indicated the diameter-class distribution of a stand of a given mean diameter. For normal stands the rotation of the maximum net income was computed at 135 years.

2096 Hellinga, G. 1956. **Efficient organization in thinning operations**. (Javanese; Dutch). Rimba Indonesia 5(9/12): 433-449.

Discusses thinning problems in Java and gives tabulated data for different species including *Tectona grandis*. Recommended thinning frequencies for *T. grandis* 14 times in 80 year rotation.

2097 Hole, R.S. 1910. **Note on the best season for coppice fellings of teak (*Tectona grandis*)**. Indian Forest Pamphlet 16 (Botany Series 1).

Describes an experiment of 1906 in Jubalpore. Trees 2-4' in basal girth selected for equal vigour and similar conditions of environment were coppiced in different months from March to September. The best results were obtained in March and September. Larger stools have more vigorous shoots.

2098 Homfray, C.K. 1934. **Technique of teak plantation work**. Proceedings of 4th Silvicultural Conference, Dehra Dun: p305.

2099 Horne, J.E.M. 1966. **Teak in Nigeria.** Nigerian Forest Information Bulletin 16: 38p.

The bulletin reviews progress of teak research in Nigeria upto 1962.

2100 Hutchins. 1909. **Teak in Brazilian East Africa**. Government Report, East African Protectorate: 79p.

2101 IUFRO. 1981. **Industrial wood production via plantations: B. Plantation systems, techniques, disease problems**. Wood production in the neotropics via plantations. IUFRO MAB USDA Forest Service. IUFRO Working Group S1.07.09, Puerto Rico, 8-12 September 1980: 137-263.

Among the papers included one paper was on spacing and thinning experiments necessary for scientific plantation management and another paper was on nutrient requirement and production potential of teak (*Tectona grandis*) plantations on alluvial sandy loams in the western llanos of Venezuela.

2102 Iyppu, A.I; Chandrasekharan, C. 1961. **Thinnings in teak**. Proceedings of the 10th Silvicultural Conference, Dehra Dun 1961 Part 2: 725-730. Forest Research Institute, India.

An account of teak plantations in Kerala and their importance in the economy are given. Thinnings and results of elite thinnings are discussed and results of thinning research carried out at Nilambur are presented. The possibility of reducing thinning cycle are pointed out.

2103 Jaski, K.C. 1909. **Elimination alang-alang in the cultivation of teak, *Ficus* and *Hevea***. (Dutch; English). Tectona 1: 145-162.

2104 Jaski, K.C. 1912. **The burning of lands to be planted**. (Dutch). Tectona 5: p846.

2105 John, R; Dattaraja, H.S; Suresh, H.S; Sukumar, R. 2002. **Density-dependence in common tree species in a tropical dry forest in Mudumalai, Southern India**. Journal of Vegetation Science 13(1): 45-56. Department of Environment and Natural Resources, Quezon City, Philippines.

Employing quadrat-based analyses, correlations of mortality, recruitment and population change with tree densities were examined.

2106 Jollye, H.C.B. 1927. **Thinning teak areas**. Indian Forester 53(9): 548-550; 52(12): 741-743.

The author opines either to cut entire multi or double leading big trees or not to cut at all and enumerates difficulties in training, felling and finances and the need for contractors to fell.

2107 Kadambi, K. 1972. **Silviculture and management of teak**. Bulletin, School of Forestry, Stephen F. Austin State University 24: 137p.

A monograph dealing with the distribution, silvicultural characteristics, natural and artificial regeneration, silvicultural systems, protection, growth and yield of *Tectona grandis* in South East Asia. Some data are also given from other tropical areas where teak is grown as an exotic. The final chapter discusses various research problems relating to the silvics, silviculture and management of teak.

2108 Kadambi, K. 1993. **Silviculture and management of teak**. 137p. Natraj Publishers, Dehra Dun.

This book presents information on the ecology, biology, silviculture and management of teak. Sections include introduction, distribution, silvicultural characteristics, natural reproduction, artificial regeneration, silvicultural systems in teak forests, protection from injury, growth and yield and research.

2109 Kale, R.B. 1962. **Teak plantations in Maharashtra State**. Maharashtra State Forest Centenary Souvenir 1847-1962: 149-153. Forest Research Institute, India.

Gives a brief description of teak forest of Maharashtra state and then deals with teak plantations under the heads - plantation sites, seed collection and treatment, teak nurseries, weeding and replacement of casualities. Thinnings, plantation time table, protection, cost of raising and financial aspects of teak plantations are discussed.

2110 Kamal Naidu, M. 1973. **Use of hormones in teak plantations**. Silvicultural Conference, 6-10 December 1973, 53. Forest Research Institute, Dehra Dun.

To overcome erratic climatic effect, particularly rainfall, in Central India region, Seradix has been used to induce early rooting and early establishment to enable tiding over the erratic period. Observations on root, shoot and height growth gave satisfactory results with Seradix application when tried by pot culture with uniform soils and same size stumps.

2111 Kaufman, C.M. 1968. **Teak production and culture in Thailand**. Journal of Forestry 66(5): 396-399.

Gives an account of teak plantations, nursery techniques and plantation methods, with growth rates.

2112 Kaushik, R.C. 1956. **Change-over to elite thinnings in Nilambur**. Proceedings of the 9th Silvicultural Conference, Dehra Dun, 1956. Part 2: 16-19.

To ensure the full final yield at 70 years in the plantations, over thinning in the past has reduced to one-half, elite thinnings were introduced in 1953-54. The technique is described in detail, elites being selected in the 10th year of new plantations.

2113 Kerbert, H.J. 1908. **Experience with (Teak) planting contractors**. Tectona 1: p597.

2114 Kermode, C.W.D. 1939. **Thinning research**. Proceedings of 5th Silvicultural Conference, Dehra Dun. Forest Research Institute, Dehra Dun.

Based on old sample plot study and teak yield tables prepared thinning instructions were given in Burma. The author makes a plea, in favour of an Indo-Burma joint investigation of the effects of different types of thinnings.

2115 Kesarcodi, S.N. 1944. **Notes on the teak plantation technique**. Bombay Forest Leaflet 1.

2116 Kesarcodi, S.N. 1946. **Bombay Silvicultural Research Trienniel programme to study the rate of growth of teak coppice and to ascertain the best method of thinning**. Proceedings of 7th Silvicultural Conference, Dehra-Dun 1946, (1951): 614-616. Forest Research Institute, Dehra Dun.

2117 Khalil, M.A.K. 1943. **Advance thinning for teak plantations**. Indian Forester 69(1): 15-19.

It is stated that heavy early thinnings are inadvisable for the following reasons: teak responds well even to late thinnings, opening up of a young crop will cause the trees to become branchy, pruning is too expensive in case of teak plantations, weed growth can be kept suppressed only as long as the canopy is closed, thinnings of the first 4 years are too small to be merchantable, heavy early opening may lead to storm damage among young shallow rooted trees, drastic opening of the canopy produces an exposure of the site which may result in the conversion of good productive soil into hard unproductive laterite.

2118 Khan, M.S. 1959. **Teak in Andhra Pradesh**. Proceedings of All-India Teak Study Tour and Symposium, Dehra Dun, December 1957-January 1958: 93-106.

Teak occurs naturally in this state. These forests are worked by the method of selection cum improvement felling and coppice with reserves.

2119 Kharche, M.L. 1974. **Silviculture and management of teak (*Tectona grandis* Linn.f.) with special reference to Madhya Pradesh**. Indian Forest College, Dehra Dun: 69p.

2120 Kongsaengthai, Ch. 1964. **Evaluation of mechanical thinning and low thinning in teak plantation**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Low thinning is a suitable method more than the mechanical thinning which can be used for first thinning.

2121 Kortz, A. 1952. **Teak forest management in Java and wildlife conservation**. (Javanese). Rimba Indonesia 1(5): 230-234.

Recommends the establishment of game reserves in areas where the soil is swampy or salty and unsuited for teak.

2122 Krishnapillay, B. 2000. **Silviculture and management of teak plantations**. Unasylva 51(201): 14-21.

This article looks at the potential of teak as a plantation species, focusing on management strategies, ecological requirements, growth performance, wood quality and availability of planting materials, with examples drawn from the Malaysian experience. It enumerates some topics of current research likely to contribute to teak plantation development.

2123 Krishnaswamy, V.S. 1953. **Thinning research in India**. Indian Forester 79(11): 581-589.

A review of current projects including thinning of teak, *Pinus longifolia*, *Shorea robusta*, *Cryptomeria japonica* and *Cedrus deodara*. A tree classification for use in thinning studies is given.

2124 Krishnaswamy, V.S. 1959. **A note on elite thinning in teak plantations in Madras state**. Proceedings of All-India Teak Study Tour and Symposium, December 1957-January 1958: 169-171. Forest Research Institute, Dehra Dun.

Thinnings carried out are described and the results are analysed. Incorrect thinnings result in open crops. A new method of elite thinning was described. The method of selection of elites and thinning were discussed. Since elites put on rapid girth increment rotation can be reduced from 70 years to 45 years.

2125 Krishnaswamy, V.S. 1960. **A description and discussion on the new method of thinning teak plantations in the Madras State**. Proceedings of the 9th Silvicultural Conference, Dehra Dun, 1956 Part 2: 31-32.

Another account with diagrams illustrating the selection of stems at each thinning.

2126 Kushalappa, C.M. 1951. **Teak in Coorg**. Madras Forest College Magazine 27(3): 109-121.

Notes on teak is given under the heads elevation, rainfall, soil and climate, occurrence of teak, how teak is grown and the desirability of growing mixed plantations, weeding and tending, thinnings, fire protection, interference by fast growing inferior species and seed origin.

2127 Kusuma Suebsaeng. 1986. **Analysis of optimum forest rotation and its social economic implications: A case study of teak in Thailand**. Kasetsart University, Bangkok: 92 leaves.

The results of optimum rotation in different site indices are given. Criteria for financial investment for teak were harvested at the optimum rotation age were benefit-cost ratio, net present value and rate of return.

2128 Lal, A.B. 1942. **Advance thinning for teak plantations**. Indian Forester 68: 430-435.

The disadvantages of both ordinary and advance thinning are discussed, and an attempt is made to justify preferential use of the latter method.

2129 Lal, A.B. 1943. **Advance thinning for teak plantations**. Indian Forester 69: 170-173.

Six points are stressed of the advantage of advance thinning in plantations.

2130 Lamb, A.F.A. 1970. **Impressions of plantation forestry in parts of India and Ceylon**. Commonwealth Forestry Institute, Oxford.

2131 Lampe, M. 1940. **Cultivated strips as fire barriers in Indramayu**. (Dutch). Tectona 33: 488-489.

The method of protection described consists teak planting on burned and cleared strips of at least 200 m. width on the windward side of last year's plantations. Owing to complete absence of litter and weeds the newly planted strip is practically immune from fire and thus protects the stands on the lee.

2132 Lande, M.L. 1987. **Studies of the management system for long rotations of man-made forests. Comparative considerations of management systems for teak plantations and cedar plantations of the Yoshino District**. (Japanese). Research Bulletins of the College Experiment Forests, Hokkaido University 44(3): 955-1017.

The management of *Tectona grandis* plantations in Indonesia is described and compared with that of intensively managed *Cryptomeria japonica* plantations near Kawakami village in Japan. Recommended planting densities and thinning regimes are given for improving teak production and quality in Indonesia.

2133 Lapongan, J. 2000. **Status of teak plantation management in Sabah**. Proceedings of the Seminar on High Value Timber Species for Plantation Establishment Teak and Mahoganies, Sabah, 1-2 December 1998. JIRCAS Working Report 16: 19-25. H.H. Chan; K. Matsumoto, Eds.

This paper briefly reports the status of teak plantations in Sabah, Malaysia, which covers the growth performance of teak in various localities, nursery techniques, plant-

ing methods and other silvicultural practices including intercropping with oil palm or cocoa. Teak is recommended for consideration for long-term plantation programmes, due to its remarkable growth performance and the high value of wood products.

2134 Larsen, C.S. 1956. **Teak**. Proceedings of the 12th IUFRO Congress, Oxford, 1956 56/22/1-A (56/5/3057): 3p.

In view of the great utilization and extensive planting of this species, the need for research is stressed and experience of Burma, Trinidad etc, are highlighted.

2135 Larson, B.C; Zaman, M.N. 1985. **Thinning guidelines for teak**. Malaysian Forester 48(3/4): 288-297.

The relation between d.b.h. and crown diameter was investigated in two plantations of 9 and 14 yr old at Cox's Bazar, Bangladesh. The regression of crown diameter on d.b.h. was linear, with a negative intercept probably due to relatively low site quality. Stand densities at full stocking are tabulated with extrapolation up to 22 inches d.b.h. Stem numbers are plotted against mean d.b.h. for various degrees of crown disengagement.

2136 Laurie, M.V. 1934. **Early stump planting**. Indian Forester 60(9): 609-612.

The author challenges some contentions with experimental data and concludes great advantage in height growth combined with a good percentage of survivals of early stump planting in moisture areas and also demonstrated the hardness of such stumps to periods of drought following the planting.

2137 Laurie, M.V. 1937. **The beginning of teak plantations in India**. Indian Forester 63(3): 151-154.

Tracing out the history of earliest teak plantations in India and also problems encountered in germinating teak seed, the enterprising work of Mr. Chattu Menon during 1843 to 1862 period was discussed and Nilambur plantations of 1846 (Conolly's plantations) was illustrated. Totally 150 acres was raised between 1846-1865.

2138 Laurie, M.V. 1938. **A rough guide to thinning teak based on average spacing for a given mean diameter**. Indian Forester 64: 397-398.

The author suggests that the minimum espacement for irregular forests of teak might be found by adding three to the diameter of the tree in inches and thinning to the same number of feet around it.

2139 Laurie, M.V. 1939. **The most paying rotation in Indian Forestry**. Indian Forester 65(7).

2140 Laurie, M.V. 1941. **Teak plantation technique**. Proceedings of the 5th silvicultural Conference, Dehra Dun, 1941: 375-381.

Discussed the selection of sites, method of stocking, stump planting, nursery work, weeding, taungya, spacing and early thinning and timber quality.

2141 Laurie, M.V. 1941. **The problem of the pure teak plantation**. Proceedings of the 5th silvicultural Conference, Dehra Dun, 1939: 123-132.

Advantages and disadvantages of pure teak plantations and matters required for further investigation are summarised.

2142 Laurie, M.V; Griffith, A.L. 1942. **The problem of the pure teak plantation**. Indian Forest Records (n.s.) Silviculture 5: 121p.

Information from various parts of India, Burma, Java and from recent publications regarding the disadvantages of pure teak plantation is summarised.

2143 Laurie, M.V; Griffith, A.L. 1943. **The problem of pure teak plantation**. Indian Forester 69(1): 33-34.

Information received from various parts of India, Burma, Java and from recent publications on the disadvantages of pure teak plantations is summarised.

2144 Leete, F.A. 1911. **Teak plantations in Burma**. Indian Forest Bulletin 2: 1-21.

Data available upto 1909 with regard to the growing stock in teak plantation in Burma are presented.

2145 Lowe, R.G. 1967. **Competition and thinning studies in Nigeria**. 9th Commonwealth Forestry Conference, New Delhi.

Describes the methods of analysis tried and the lay-out of experiments in *Nauclea diderrichii*, *Tectona grandis* and *Terminalia ivorensis*.

2146 Lowe, R.G. 1968. **Thinning teak**. Bulletin Nigerian Forest Department 28: 2-4.

2147 Lowe, R.G. 1976. **Teak (*Tectona grandis* Linn.f.) thinning experiment in Nigeria**. Commonwealth Forestry Review 55(165): 189-202.

Pattern analysis of basal area increment showed that even for the heaviest thinning, the fastest growing individuals, both before and after treatment, tended to remain the fastest.

2148 Lugt, C.S. 1908. ***Tectona grandis* planting in forest district Bodjonegoro (Java) under contract without simultaneous cultivation of rice**. Tectona 1: 546-556.

2149 Lushington, A.W. 1907. **Is a period of rest and rotation of crops wanted for teak reproduction?** Indian Forester 33(9): 409-415.

In Nallamalais forest of Kurnool, clear fellings in 1901 resulted in plentiful natural regeneration of teak. Teak was abundant in these forests, whereas in eighties and nineties a totally different forest type arose by which teak is temporarily ousted and from 1901 onwards, when this forest was clearcut, teak sprang up in abundance from seed which must have laid dormant in the ground for many years.

2150 Mahapol, S. 1954. **Teak in Thailand**. Royal Forest Department, Bangkok Report R.16; FAO Asia Pacific Forestry Commission FAO/APFC 55/54: 31p.

Covers ecology, silviculture, injuries and protection, yield and increment.

2151 Maitland, V.K. 1927. **Thinning teak areas**. Indian Forester 53(7): 425-427.

Thinning teak areas and singling out double or multi stems, the author advocates the desirability and profitability of forest of single straight stems.

2152 Maldonado, E.D; Boone, R.S. 1968. **Shaping and planning characteristics of plantation grown mahogany and teak**. Institute of Tropical Forestry, Rio Piedras, United States Forest Service Research Paper ITF-7: 22p.

Mahogany and teak are proved superior in shaping and planing properties to all other woods tested. It is found that plantation grown timbers including *T. grandis* yielded wood as good as the imported forest-grown material in shaping.

2153 Marigoudra, R.M; Madiwalar, S.L. 2004. **Effect of planting methods and fertilizer levels on initial growth and foliar nutrient contents of teak**. Karnataka Journal of Agricultural Sciences 17(1): 72-75.

A field experiment was conducted to study the effect of planting methods and fertilizer levels on the initial growth increment of teak planted on bunds of upland paddy field in Mundgod, Karnataka, India.

2154 Marshall, R.C. 1929. **Growing teak in Trinidad**. Tropical Woods 19(1/3).

Teak was first introduced in Trinidad in 1913. 15-16 years old plantations have an average height of 70 ft. and m.a.i. was 126 cu.ft./acre based on sample plot studies. Notes on nursery and planting methods of teak, care of young plantations were also given.

2155 Marshall, R.C. 1930. **Silvicultural notes on the more important timber trees of Trinidad and Tobago with information on the formation of woods**. Trinidad Government Printing Office.

Tectona grandis is one of the many species included.

2156 Marshall, R.C. 1939. **Silviculture of the trees of Trinidad and Tobago, British West Indies**. Oxford University Press, London: 189-192.

Tracing its introduction to 1913, distribution, habitat, germination, seedling and silvicultural characteristics, artificial regeneration methods, nursery, techniques, and later tending, thinning etc., are discussed. Some statistical data are presented and utilization aspect is also discussed.

2157 Marten, K.D; Thomson, B.R. 1980. **The silvics of species**. Forestry Division, Solomon Islands, Research Reports S-1-12-80: 119p.

A summary of the performance of the major plantation species including teak in divisional trials plots, which have shown promise in trials and are already used in the Solomons afforestation programme.

2158 Mathur, C.M. 1961. **Rehabilitation of degraded dry teak forests of Rajasthan**. Proceedings of 10th Silvicultural Conference, Dehra Dun, 1961, Part 2. Forest Research Institute, Dehra Dun.

A description of degraded teak forests and the various measures taken for their rehabilitation are given and results of working them are indicated.

2159 Matos Gonzalez, E. 1972. **Description and analysis of growth of the teak (*Tectona grandis*) plantation at Itabo Experimental Station, Marti, Matanzas**. Baracoa 2(2): 22-31.

The data show that on the infertile clay soil found at Itabo growth is good in the early stages but decreases later because the

roots are unable to penetrate the dense clay subsoil. A subsoiling treatment and application of fertilizer are recommended, together with further thinning and retention of part of the stand for experimental purposes.

2160 Mensbruge, G de la. 1956. **Enrichment of the Upper Ivory Coast savanna - introduction of teak**. (French). Proceedings of the 4th World Forestry Congress, Dehra Dun, 1954: 312-321.

The teak plantations described are protected and are thinned every 5 years from 6-8 years onwards. The objective is to introduce indigenous species under the teak and restore the original forest cover.

2161 Metcalfe, J. 2002. **Strategic feeding, vigorous seedlings, healthy trees**. Partners in Research for Development 15: 23-30.

Results are presented from projects which have investigated the nutritional aspects of forest plantations including teak in the western Pacific and north Queensland, Australia. The project focused on the early growth of tree seedlings in nurseries, techniques for determining nutritional needs and the use of slow release fertilizers and coir potting mixtures. Another project examined the nutrient requirements of plantation timber trees, the development of efficient fertilizer strategies and the effect of tree harvesting on the nutrient capital of a site.

2162 Minchin, A.A.F. 1929. **The problem of pure teak plantation**. Proceedings of the 3rd Silvicultural Conference, Dehra Dun: 83-87.

2163 Mirchandani, T.K. 1941. **Treatment of teak plantations**. Indian Forester 67: 399-402.

An example of a proposed method of obtaining mixed stands is outlined on the basis of a 135-year rotation and initial spacing of teak at 6 X 6 ft.

2164 Mohanty, A.P. 1956. **Progress of teak plantation in Angul**. Indian Forester 82(4): 197-202.

Planting of teak began in this division of Bihar and Orissa in 1886. Described the methods of planting and treatment of the plantations. Some growth data are also given.

2165 Moni, A.S. 1951. **Forests (plantations) Pure v/s mixed with reference to teak**. Madras Forest College Magazine 27(3): 121-127.

Discusses the relative merits and demerits of raising pure and mixed plantations.

2166 Moni, G. 1959. **Short history of the Konni teak plantations**. Proceedings of All-India Teak Study Tour and Symposium December 1957-January 1958, Dehra Dun: 164-165.

Gives a short history of teak forests and plantations at Konni which started with an espacement of 6'x6' in 1870 to taungya plantations in 1920. Describes the technique of raising plantations. Eupatorium spp. a weed is suppressing teak and also effected by water blister diseases.

2167 Moore, D. 1962. **Utilization of teak thinnings in Trinidad and Tobago**. Caribbean Forester 23(2): 82-86.

Teak was introduced into Trinidad in 1913 and a factory producing fence posts, and lumber from small size teak thinnings which has proved profitable is now in operation. The factory also disposes slash from forest, thus removing fire-hazard, creates rural employment and publicises qualities of locally grown teak.

2168 Mueller Darss, H. 1973. **An ergonomic case study to determine a fair day's work: A study of thinning in a teak plantation in a tropical climate**. Forstarchiv 44(11): 243-244.

Describes a study of performance, pulse frequencies and energy consumption of one worker during thinning operations in a 10-year-old teak plantation on the S. slope of the Venezuelan Andes in a tropical climate.

2169 Mueller Darss, H. 1973. **Ergonomic case study to determine labour performance: A study of thinning in a teak plantation in a tropical climate**. Boletin, Instituto Forestal Latino Americano 44-45: 51-55.

2170 Murillo, O. 1991. **Methodology for quality control in forest plantations**. Tecnologia en Marcha 11(1): 19-29.

The paper describes the development of criteria and attributes for evaluating individual trees of different species including *Tectona grandis* for fuelwood, saw timber or pulp.

2171 Neumann, A.J. 1987. ***Tectona grandis* spacing/thinning trials - interim results**. Forest Division, Solomon Islands, Forestry Note 23-6-87: 6p.

It is found that height increased with increased stocking. The regression of merchantable height on stocking indicated an increase of 1.1 m in height with an increase of

400 stems/ha. An equation is given for the thinning ratio.

2172 Noltee, A.C. 1923. **About plantations in the teak forest region**. (Dutch; English). Tectona 16(8/9): 667-681; Korte Meded Proefsta Boschw 6: 1-28.

Described the clearfelling, slash burning, preparation of planting site, planting espacement and use of soil cover etc. of the teak plantations of Java. Hints are given on collection and storing of seed and nursery methods and introductions of mixtures. The past treatment and management of old forests are discussed. Principles for clear cutting and replanting are outlined.

2173 Noor, H.M. 2002. **The growth response of a 20-year-old teak (*Tectona grandis* Linn.f.) stand to thinning intensity**. Malaysian Forester 65(4): 198-209.

A thinning experiment was conducted in a 20 year old stand of teak and found that the thinning treatments improved the diameter, basal area and volume growth of teak trees. It is found that 40 percent thinning gave the best basal area and volume growth.

2174 Nwoboshi, L.C. 1971. **A preliminary report on the application of row, electic and basal area thinnings on an 8 year old teak stand**. Department of Forestry, Ibadan University, Research Notes 1(1): 1-4.

Six thinning treatments were applied in a Nigerian plantation of *Tectona grandis* combined low and crown thinning, row thinnings in which every third or every second row was removed, two intensities of electic thinning in which all trees, dead or alive/along a row were compared in progressive groups of four or five and the best tree in each group was retained and unthinned control. Data are given to show the effect of thinning treatment on the quality of the stand.

2175 Nynetr, M. 1970. **Thinnings in teak plantation**. (Thai). Vanasarn 28(1): 33-45.

Five methods of thinning followed in Thailand are described and recommendations are made on thinning cycles to be adopted.

2176 Oever, H.Ten. 1909. **Miscellancy from thinning practice and teak plantations**. Tectona 1: 440-444.

2177 Oever, H.Ten. 1918. **Notes on *Tectona grandis* in Bantam**. Tectona 2: 283-289.

2178 Ohn Maung. 1968. **Control of thinning of teak plantations in Burma**. Union Burma Journal of Life Science 1(2): 194-199.

A close linear correlation is shown to exist between the logarithm of number of stems per acre and the logarithm of average diameter, which can be used to calculate the stem number as given in the yield tables for a given average diameter.

2179 Ola-Adams, B.A. 1990. **Influence of spacing on growth and yield of *Tectona grandis* Linn.f. (teak) and *Terminalia superba* Engl. & Diels (afara)**. Journal of Tropical Forest Science 2(3): 180-186.

The effects of spacing in relation to growth and wood production in 18-yr-old *Tectona grandis* was investigated. The results showed that percentage survival, diameter at breast height and specific gravity increased with increasing spacing while merchantable height, stem volume and basal area decreased with increasing spacing.

2180 Ola-Adams, B.A. 1993. **Effects of spacing on biomass distribution and nutrient content of *Tectona grandis* Linn.f. (teak) and *Terminalia superba* Engl. & Diels. (afara) in south-western Nigeria**. Forest Ecology and Management 58(3/4): 299-319.

The effects of four different spacings on biomass and nutrient distribution were studied. There were significant differences between spacings in dry weights of small branches and big roots. No consistent pattern of total nutrient content with spacing is reported in the case of teak.

2181 Ola-Adams, B.A; Egunjobi, J.K. 1992. **Effects of spacing on litterfall and nutrient contents in stands of *Tectona grandis* Linn.f. and *Terminalia superba* Engl. and Diels**. African Journal of Ecology 30(1): 18-32.

The rate of litterfall was high in the dry season in *Tectona grandis*. There were no significant differences between spacings in either species in relation to amount of litterfall or nutrient content of litterfall.

2182 Patel, R.I. 1967. **Note on thinning in coppice crop of teak**. Proceedings of the 11th Silvicultural Conference, Dehra Dun, 1967, Part I, Item h(1). Forest Research Institute, Dehra Dun.

The dry and very dry teak forests of Madhya Pradesh, Gujarat, Rajasthan and Maharashtra were mainly managed under coppice crop. Here stressed the need for further studies for finalising thinning research.

2183 Perera, W.R.H. 1962. **The development of forest plantations in Ceylon since the seventeenth century**. Ceylon Forester 5(3): 142-151.

Reports that teak was first introduced in Ceylon in 1680.

2184 Perera, W.R.H. 1975. **Teak first thinnings for paper pulp**. Sri Lanka Forester 12(1): 50-51.

First thinnings of *Tectona grandis* were tested for the kraft pulp process and the semi-chemical pulp process and five grades of kraft paper were produced.

2185 Perez, L.D; Viquez, E; Kanninen, M. 2003. **Preliminary pruning programme for *Tectona grandis* plantations in Costa Rica**. Journal of Tropical Forest Science 15(4): 557-569.

An investigation was carried out to study the structure and composition of the crown biomass to develop a pruning programme for teak in Costa Rica. The results indicate that the first pruning should be carried out when trees reach a height of 4 to 5 m and the second pruning should be done when the stand reaches 9 to 10 m of height.

2186 Phrombupha, A.S; Indrachanjra, P.K. 1967. **Study on the effect of different intensities of thinnings on the increment of teak in plantation**. Proceedings of the First Silvicultural Seminar, Royal Forest Department, Ministry of Agriculture, Bangkok: 83-87.

Significant difference is observed in different intensities of thinning control, 50 percent, 60 percent, 70 percent and 80 percent thinning of basal area.

2187 Pieters, A; Maerschalk, J de. 1973. **A teak plantation in the Kinshasa Region (Zaire)**. Sylva Gandavensis 40: 42p.

Discussed soils, vegetation, planting methods, initial spacing, treatment, structure, stem form and quality, increment, standing volume, etc of the plantation. Silvicultural recommendations are made based on the observations.

2188 Pillai, R.D. 1933. **Stump transplanting of teak in Travancore**. Indian Forester 59(1): p119.

Nursery methods, stump preparation and planting are described in detail.

2189 Pillai, R.D. 1933. **Stump transplanting of teak in Travancore**. Indian Forester 59(4): 259-261.

Quoting instructions of Mr. Bourdillon, traces the stump planting in the state to 42 years ago in 1890-91 and states it was the universal practice for the last 30 years in the state.

2190 Piotto, D; Montagnini, F; Kanninen, M; Ugalde Arias, L.A; Viquez, E. 2002. **Forest plantations in Costa Rica and Nicaragua: Species performance and farmers preferences**. (Spanish). Revista Forestal Centroamericana 38: 59-66.

This study took place in commercial plantations including *Tectona grandis* in 112 forest production farms in Sarapiqui, Costa Rica, and Carazo, Nicaragua. An inventory of forest plantations was conducted. The evaluated variables were tree survival, canopy gap, total height, form and health.

2191 Plasschaert, E.K. 1911. **More intensive teak cultivation methods**. (Dutch; English). Tectona 4: 609-614.

2192 Pongsopha, Ch. 1962. **Comparison of teak growth resulting from different degrees of thinning**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Thinnings carried out with 50 percent, 60 percent, 70 percent and 80 percent, compared with normal thinnings. The basal areas recorded for various grades of thinnings shows control differed only from 80 percent thinning significantly in height growth, which increased after thinning. Heavy thinning is considered desirable for teak.

2193 Porapakkharm, Ch. 1963. **A comparison of growth in planting teak stumps with root and rootless stumps**. (Thai). Thesis. Kasetsart University, Bangkok.

It is observed that growth of stumps with root is better than that of without root and also have higher survival percentage.

2194 Prakong Intrachandra. 1975. **Efficiency comparison between mechanized and hand weeding at Ban Dan Lan Hoy teak plantation, Sukhothai province**. Forest Research Bulletin, Faculty of Forestry, Kasetsart University, Thailand 32: 25p.

A comparison of costs of mechanized and hand weeding in a teak plantation is made and showed that unless at least 1800 rai were to be weeded annually, hand weeding was preferable to mechanized weeding.

2195 Prasad, R. 1973. **Limitation of formula thinning in teak forest of M.P**. Forestry Confer-

ence (Silvicultural Conference) 6-10 December 1973, 81. Forest Research Institution, Dehra Dun.

It suggests that in early stage at least more stems per unit area be retained and the crop can be opened up more at a later stage for higher diameter increment. A modified formula is suggested using girth instead of diameter.

2196 Prasad, R. 1987. **Technological planning *vis-a-vis* plantations: A case study of Kesla Project, Hoshangabad**. Journal of Tropical Forestry 3(3): 198-206.

The causes of the failure of the teak or teak and bamboo plantations established at Churna in the Hoshangabad Forest Division (Kesla), Madhya Pradesh are discussed. Ways of improving the site for teak and better planting techniques are discussed.

2197 Qureshi, I.M. 1956. **Problems of thinning in coppice teak crops**. Proceedings of the 9th Silvicultural Conference, Dehra Dun, 1956. Part 2: 1-2.

Treatments, lay-out and experimental design are discussed.

2198 Rahman, A; Mustanoja, K.J. 1978. **Optimum rotations for forest plantations in Bangladesh**. Bano Biggyan Patrika 7(1/2): 48-59.

It is a review of the important published models of rotations, which are classified as service rotations, physical rotations and financial rotations. A case study is given to illustrate the differences in rotation prescribed by the models based on data for teak from Bangladesh.

2199 Rajarajan, A; Surendran, C; Balamurugan, J. 2001. **Root activity pattern of *Tectona grandis* under two different espacements**. Madras Agricultural Journal 88(7/9): 517-519.

Results of a study conducted to investigate the root activity of teak under different spacings and various soil depths using the radio tracer 32p orthophosphoric acid are presented.

2200 Ram, B.S. 1939. **Thinning research**. Proceedings of the 5th Silvicultural Conference, Dehra Dun: p199. Forest Research Institute, Dehra Dun.

Reports on replicated and unreplicated experimental plots laid out in Central Provinces, Coorg and Madras states.

2201 Ram, B.S. 1946. **The price-age gradient of Bori teak**. Indian Forest Bulletin (n.s.) Silviculture 132: 15p.

A study was undertaken for determining the most profitable rotation. The analysis of the data recorded shows that the net price per tree varies directly with age that the price per cu. ft. continues to rise up to the age of 120 years. The study indicates that the rotation of highest net income lies somewhere beyond the age of 120 years.

2202 Ranjit Singh, T. 1907. **An experiment on growing teak (*Tectona grandis*) by live teak stakes in the Narasingarh, State Central India**. Indian Forester 33(6): 283-284.

Performance of live stakes of teak planted in two different types of soils of Narasingarh, Madhya Pradesh is investigated.

2203 Raunio, A.L. 1975. **Clean weeding improves growth of teak in Longuza**. Silviculture Research Station, Tanzania, Technical Note 25: 6p.

2204 Robertson, B. 2002. **Growing teak in the top end of the Northern Territory (*Tectona grandis*)**. Agnote Northern Territory of Australia G26: 5p. Department of Primary Industries and Fisheries, Northern Territory of Australia, Darwin, Australia.

The germination, planting material, soil requirements, site preparation and planting, thinning, uses, seasoning, durability, working qualities and pests and diseases of teak in Northern Territory, Australia are presented.

2205 Rojas, O; Murillo, O. 2000. **Quality of teak plantations in the Nicoya Peninsula, Costa Rica**. (Spanish). Agronomia Costarricense 24(2): 65-75.

Twenty five 6-year old teak reforestation projects in Nicoya and Hojancha counties, Nicoya Peninsula, Guanacaste, Costa Rica were evaluated. Results indicate that more than 48 percent of the plantations in this region show an acceptable quality.

2206 Roosendael, J van. 1928. **Thinning of Tectona plantations in Java**. Tectona 21: 803-840.

2207 Ross, P. 1958. **Herbicide control of coppicing in teak**. Botanical Gazette 120(1): 59-61.

Presents the results of experiments on the use of various growth-regulators to pre-

vent coppicing of teak stumps after thinning in plantations in Trinidad.

2208 Roychoudhury, K.C. 1959. **Teak plantations of West Bengal**. Proceedings of All-India Teak Study Tour and Symposium, December 1957-January 1958, Dehra Dun: 176-178.

Describes the present day technique of raising teak plantations in West Bengal. The problems confronting raising teak plantations have also discussed.

2209 Sagreiya, K.P. 1946. **Single stem silviculture**. Indian Forester 72(11): 515-526.

A method of tending irregular teak crops of coppice origin is described. The best of the dominant stems are selected for retention and given the optimum growing space by felling the inferior dominant and dominated stems interfering with the crowns.

2210 Sagreiya, K.P. 1947. **Single stem silviculture**. Indian Forester 73(7): 323-329 .

Describes how the normal N/D curve could be used as a guide to thin teak plantations and to measure and control the intensity of thinning.

2211 Sagreiya, K.P. 1952. **Single stem silviculture**. Indian Forester 78(4): 199-205.

Advocating a method of thinning irregular crops of teak.

2212 Sagreiya, K.P. 1955. **Single stem silviculture**. Indian Forester 81(12): 753-764.

Suggests the use of the N/D correlation for teak of coppice origin in the same manner as the N/V correlation has been used by O'Connor for solving a variety of specific problems connected with thinning regimes.

2213 Sagreiya, K.P. 1956. **Practicable thinnings (in naturally regenerated young crops of teak)**. Indian Forester 82(11): 553-561.

The paper describes a method of thinning irregular young crops of teak, of coppice, seedling-coppice and seedling origin. It prescribes selection of the best stems and then giving each of them the optimum growing space, according to the formula D = 1.5(d + 4) where D is the diameter of the growing space in feet, and d the diameter of the stem in inches.

2214 Sandrasegaran, K. 1966. **Optimum planting distances and crop densities of the ten exotic species in Malaya utilising triangular spacing based on a consideration of crown diameter to stem diameter relationship**. Forest Research Institute, Kepong, Research Pamphlet 51: 44p.

Crown diameter relationship to stem diameter is discussed and the range of kd/d relationship considered for ten exotic species including *Tectona grandis*. Tables are provided showing optimum planting distances and the corresponding crop densities and basal area.

2215 Sarlin, P. 1966. **The first thinning in teak plantations**. (French). Bois et Forests des Tropiques 108: 5-20.

It is showed that increment was markedly depressed before thinning, but was resumed later, especially by the larger trees. The merits of several methods of determining the best age for thinning are examined, viz. soil analysis before planting, stem analysis, measurement of relative illumination and empirical observation of the stand.

2216 Scholten, F.K. 1932. **Remarks on water cuttings and branch formation in the young plantation teak**. Tectona 25: 808-809.

2217 Sekar, T. 2000. **Twentieth century milestones in Tamil Nadu forestry**. Indian Forester 126(1): 3-8.

The salient aspects are described of four noteworthy achievements in the field of production forestry in Tamil Nadu during the 20th century. These include silvicultural practices relating to river fringe and canal bank plantations of teak.

2218 Sen Gupta, H. 1934. **Early stump planting of teak**. Indian Forester 60(3): 238-239; 171; 609.

Details of the methods of stump planting are discussed and compared with those of Devekar.

2219 Sen Gupta, J.N. 1936. **Best date for premonsoon planting of teak stumps**. Indian Forester 62(7): 434-435.

Suggests best and safest period for South West monsoon areas is from mid April to mid May. Burma experience of premonsoon stump planting with banked up soil around stumps gave better height growth and reduces casualities.

2220 Seth, S.K. 1957. **Report from India on silviculture and management of teak. I. Teak races and seed origins. II. Teak soils**. FAO Teak Sub-Commission, Bandung FAO/TSC-57/7: 21p.

A review of the literature covering India, Burma, Indonesia and Pakistan, and discussing structure, nutrients and water relations, geology, pH and soil deterioration and soil conservation in teak plantations.

2221 Seth, V.K. 1958. **Thinnings in young teak coppice forests of the Betul division**. Indian Forester 84(9): 568-570.

Describes the method of thinning used of single stem silviculture.

2222 Shirley, G.S. 1928. **Effect of neglect of thinnings in teak plantations**. Indian Forester 54(3): 170-172.

The author reports that neglect and delay of thinnings results in congestion of crowns, poor undergrowth, erosion and slow girth increment and deficient volume.

2223 Shirley, G.S. 1928. **Note on the natural thinnings in young teak plantations**. Indian Forester 55(4): 225-227.

From sample plot studies of thinned and unthinned teak plantations of Kaing reserve, Rjinniana division, Burma, the author gives figures and data of number of stumps and casualities. Data of growth and increment for dominant trees is given for thinned and unthinned plantations.

2224 Sibomana, G; Makonda, F.B.S; Malimbwi, R.E; Chamshama, S.A.O; Iddi, S. 1997. **Effect of spacing on performance of teak at Longuza, Tanga, Tanzania**. Journal of Tropical Forest Science 10(2): 176-187.

Results showed that dbh, number of branches, total height, basal area, basic density and some strength properties were significantly affected by spacing. The diameter at breast height and number of branches increased with increasing spacing, while basal area decreased.

2225 Singh, B. 1962. **Degraded teak forests of Rajasthan and their rehabilitation**. Indian Forester 88(4): 285-288.

Describes operations carried out which include cutting back the degraded crop, tending the subsequent coppice regrowth and planting up gaps.

2226 Singh, P. 1948. **Single stem silviculture and the conception and classification of thinnings**. Indian Forester 74(2): 73-77.

A criticism of Sagreiya's proposed system for thinning teak, in the light of the writer's tree-classification system.

2227 Sirito, N.B; Ole Meiludie, R.E.L. 1991. **Productivity and costs for different cutting methods in thinning a teak plantation**. Faculty of Forestry, Sokoine University of Agriculture 48. Morogoro, Tanzania.

A study was carried out to evaluate production rates and costs for five commonly used cutting methods in thinning. Detailed time studies on two-man crosscut saw, one-man crosscut saw, axe and chainsaw cutting operations were undertaken at the Mtibwa Forest Project in a single stand where selective thinning operations were underway. Time study and production data were analysed to develop statistical equations that were used to estimate productive cutting time per tree for each of the methods. Production rate equations and estimates of unit cutting costs were provided.

2228 Sisukho, M. 1977. **Thinning technique in teak plantation**. (Thai). Proceedings of the National Forestry Conference, Bangkok, 16 December 1976. Ministry of Agriculture and Cooperatives, Bangkok.

2229 Snepvangers, F.W. 1925. **The age of natural teak forests**. Tectona 15: 602-605.

2230 Snepvangers, F.W. 1930. **Notes on *Tectona grandis***. Tectona 23: 119-126.

2231 Snepvangers, P.W. 1929. **Thinning of teak forests**. Tectona 22: 294-297.

2232 Soeters, K. 1915. **Rotation in teak forests**. Tectona 8: 443-452.

2233 Srivastava, S.S. 1959. **Management of teak forests under coppice system in former Madhya Pradesh *vis-a-vis* natural regeneration of teak**. Proceedings of All-India Teak Study Tour and Symposium, Dehra Dun, December 1957-January 1958: 143-147.

After giving a short description of teak forest of Madhya Pradesh and their history, the author suggests detailed treatments for obtaining natural reproduction of teak after working the forest under coppice with reserve system.

2234 Stebbing, E.P. 1900. **Note on the Myautaung teak plantation in the Arracan District, Burma**. Indian Forester 26(4): 163-167.

Detailed notes on the present condition, situation, method of raising are given and recommendations are made for future treatment of these plantations.

2235 Sudarmo, M.K. 1957. **Thinning studies**. FAO/Teak Sub-Commission, Bandung FAO/TSC-57/27: 2p. FAO, Rome.

Describes Indonesian practice, in which thinning from below and the use of Hart's stand density index are reported to be prevalent.

2236 Suraphapmaitri, S. 1986. **Yield-density effects teak plantation**. Kasetsart University, Bangkok: 66 leaves.

The result showed that diameter class as ground level and total height of each stand density were inversely correlated to the stand density as stand age increased. Values of competition-index in various components indicated the increasing trend with stand density and stand age and differed among each component of trees. Growth coefficient of each fraction increased following to stand age.

2237 Tandon, M.N. 1972. **Teak plantation near Marripakalu seen from a height of 500 feet East Godavari, A.P**. Indian Forester 98(3).

2238 Teak Improvement Centre, Ngao. 1974. **Progress report-July 1973-June 1974**. Progress Report October 1974: 12p. Teak Improvement Centre, Ngao.

The Thai-Danish co-operation ends on 25-1-1975. It includes, provenance studies both in the nursery and field. The stump budding technique was illustrated and explained, with promising results of 98 percent. The work undertaken during the year, on seed orchards and seed source areas is explained. Pollination studies include, results of different pollination methods between clones and also with reference to the percentage of fruit developed and their germination in nursery. Silvicultural trials include spacing, seeding, pruning and thinning trials, nursery and seed investigations, seed storage studies, manuring and fertilizer trials, stump storage trials etc. A final evaluation and recommendations were made of the project for the period 1965-1975 to DANIDA.

2239 Thaiutsa, B; Kajornsrichon, S; Tiyanon, S. 1992. **Research of teak plantation**. Proceedings of the Seminar on 50 Anniversary of Hyay-Tak Teak plantation, Bangkok, 5-8 August 1992.

Huay-Tak teak plantation is the center of field researches in all aspect of teak establishment. Research at this plantation include seed collection, seed storage, seed germination, provenance trials, stump storage, spacing trials, site quality index, growth performance, pest damage, thinning, rotation and economic returns.

2240 Thomson, B.R; Thomson, B.R. 1980. **Spacing strategies for plantations in the Western Solomons**. Forestry Division, Solomon Islands, Forest Research Note 7-80: 7p.

The causes of the poor performance of line-planted stands on logged areas in the Solomons are discussed. Suitable spacing and thinning strategies are discussed for different sites and species including *Tectona grandis*.

2241 Tiwari, S.D.N. 1966. **Some observations on teak plantations**. Indian Forester 92(12): 745-748.

Establishment of large scale nurseries, control of sprouting before conversion to root shoot cutting, rejection of slow growing plants, use of fertilisers and adoption of a shorter planting distance are some of the measures suggested by the author to raise teak plantations on a large scale at minimum cost.

2242 Trevor, C.G. 1926. **Thinning teak areas**. Indian Forester 52: p677.

Emphasizes the need for early thinnings and pruning unsound branches upto 6" diameter to improve yield.

2243 U Kyaw Zan. 1953. **Note on the effect of 70 years treatment under selection system and fire protection in the Kangyi Reserve**. Burmese Forester 3(1): 11-18.

As because of forest received regular treatment under working plan prescriptions from 1870 to 1941 without a break, its value and revenue were greatly increased. The two most valuable species were *Tectona grandis* and *Xylia dolabriformis*.

2244 Vahid, S.A. 1927. **Thinning teak areas**. Indian Forester 53(12): 741-743.

Practical difficulties in removal of double stems and pleads for further investigations on the problem and its effects.

2245 Venkataramany, P. 1956. **Teak plantations - thinning research**. Proceedings of the 9th Silvicultural Conference, Dehra Dun. Part 2: 33-38.

A detailed account of the work and periodic results in the Wyanad and Nilambur divisions. Figures are provided to show that Craib-type thinnings give rapid diameter increment but less volume than D-grade thinnings, leaving height unaffected.

2246 Wanichkul, M. 1966. **A study on the growth and percentage of survival of teak stumps of different size and lengths**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Size and length of stumps have no effect on growth and survival percent, but stumps of 1.0 to 2.0 cm. diameter and 16-20 cm. long gave best survival.

2247 Watts, H.C. 1934. **Technique of teak plantation work**. Proceedings of the 4th Silvicultural Conference, Dehra Dun: p301.

2248 Wechel, A te. 1909. **An incomplete description of the principle of thinning in teak plantations**. Tectona 2(1): 74-77.

2249 Weidema, W.J. 1966. **An information on teak growth in Nicaragua**. Turrialba 16(4): 387-389.

A note on a promising 1-ha. plantation established in 1946. Total yield (including two thinnings) is estimated.

2250 Wepf, W. 1936. **Root competition and the balance applied in setting out and thinning teak**. (Dutch; English). Tectona 29(11/12): 847-856.

2251 White, K.J. 2002. **General plantation management**. TEAKNET Newsletter 26: 4p. 25.

2252 Wilson, C.C. 1934. **Early stump planting of teak**. Indian Forester 60(2): p171.

Reports on the Madras experiments in Nilambur and Wyanad.

2253 Wilson, C.C. 1938. **On teak plantations of Nilambur**. Inspection Notes on the forests of Nilambur Division.

The note gives recommendations on thinning in teak plantations.

2254 Wimbush, A. 1922. **Teak plantations**. Indian Forester 48(12): p687.

The author mentions an espacement of 8'x8' adopted in a Nilambur plantation and considers it as too wide resulting in catapult forking generally about 15 ft. from the ground level.

2255 Wiroatmodjo, R.S. 1953. **The rotation of teak**. (Javanese). Rimba Indonesia 2(5): 210-218.

After a discussion of the merits of long and short rotations the author recommends short rotations of 40 years and intensive management of forests.

2256 Wood, P.J. 1966. **A guide to some German forestry plantations in Tanga region**. Tanzania Notes and Records 66: 203-206.

The old German plantations since 1898 to 1911 are listed along with their provenance. Detailed notes are included on Kihuhwi, Amani, Muchesa, Steinbruch and Tanga region teak plantations.

2257 Wood, P.J. 1967. **Teak planting in Tanzania**. Proceedings of FAO Symposium, Man Made Forests, Canberra, Australia FO:MMF-6/10: 1631-1644.

Details of local seed stands and early German introductions dating from before 1914 are given, together with the location and description of today's plantation area. Nursery practice, general silvicultural techniques, the growth figures from sample and trial plots are also described. Reference is made to provenance, progeny and grafting trials to recent work on plantation and nursery diseases and to tests on the timber properties of Tanzanian grown teak.

2258 Wyatt Smith, J. 1967. **Interim note on experiments with different types and sizes of teak planting stock: Western Nigeria**. FAO Teak Sub-Commission, Rome: 4p. FAO, Rome.

2259 Zwart, W. 1937. **Selective thinning**. (Dutch). Tectona 30(3): 17-201.

Teak stands are analysed by tree types adapted from 'Schadeline'.

Go top

Field Trials

(See also 1692)

2260 Bhat, D.M; Hegde, H.G; Hegde, G.T; Murali, K.S. 2002. **Field performance of certain selected species in hilly region of high rainfall zone in Uttara Kannada District, Western Ghats, Southern India**. Myforest 38(4): 357-363.

Mean annual increment of collar diameter, height and volume was computed and a rank was developed. Teak was found fast growing with high survival next to *Acrocarpus fraxinifolius*.

2261 Muralidharan, E.M; Pandalai, R.C. 2000. **Assessment of field performance of micropropagated teak and Eucalypt**. KFRI Research Report 182: 21p. Kerala Forest Research Institute, Peechi.

A field trial was conducted at the KFRI Field Research Centre, Veluppadam, Thrissur, for assessing the performance of micropropagated plantlets of *Tectona grandis* and *Eucalyptus tereticornis* with respect to their vigour and field hardiness as compared to the conventional planting material used in forestry plantations. Observations on mean survival, height and girth at breast height were recorded at two monthly intervals. In teak, survival of both the propagules was above 90 per cent during the initial months. The survival rate was 76 percent in micropropagated teak plants and 83 per cent in conventional stump plants.

2262 Parashar, K.K; Tiwari, S.K; Dhuria, S.S. 1995. **Field trials of tissue culture grown plants of teak (*Tectona grandis* Linn.f.)**. Vaniki Sandesh 19(2): 1-3.

A preliminary note on the successful transfer of plants to the fields raised by tissue culture using shoots taken from seedlings raised from the seeds of plus trees.

2263 Subramanian, K; Thakare, A.R; Paranjpe, S.V; Khuspe, S.S. 1997. **Preliminary field trials with tissue culture plants of teak in Maharashtra**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 157-159. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Preliminary field trials on teak tissue culture plants were taken up in Maharashtra since 1978. The tentative results indicate that the growth performance of teak tissue cultured plants are better than that of the plants raised from conventional stumps or polypot plants. The applications of tissue culture technology in forestry and the emerging research needs are enumerated.

Go top

Fertilizer Trials

(See also 0196, 0243, 0625, 2153, 2963, 3435, 3707, 3980)

2264 **Application of farm-yard manure to teak seedlings**. Forest Research in India, 1930: p15.

2265 **Irrigated teak plantations**. Forest Research in India and Burma Part II, 1947: p53.

The stopping of irrigation after 4-6 years has no significant difference in mean height and were advocated at the end of four growing seasons.

2266 **Teak-manurial experiments in Nilambur**. Forest Research in India Part II 1954-55, 1955: p74.

Application of 4 oz., super-phosphate per plant promotes more rapid height growth. Further investigation are required to show whether weeding costs can be reduced to counter balance the cost of application of manure.

2267 Adukkham, S. 1962. **The scientific fertilizers as experimented with teak**. Thesis. Kasetsart University, Bangkok.

2268 Ananthapadmanabha, H.S; Nagaveni, H.C; Vijayalakshmi, G; Somashekar, P.V. 1998. **Comparative effect of inorganic and biofertilizer on growth of teak plants**. Indian Journal of Forestry 21(1): 1-3.

Six treatments were applied: application of calcium nitrate, diammonium phosphate, inoculation with *Glomus caledonium* VAM spores or composite teak rhizosphere VAM and no treatment. Plant growth, foliar nutrients and root VAM infection, and soil nutrients and VAM spores were measured for two years after treatment. All the treatments improved teak height growth, with the best growth in VAM treatment.

2269 Arthur, M.B. 1999. **The effect of compost and NPK fertilizer on growth performance of *Tectona grandis* Linn.f. seedlings in the nursery**. Ghana Journal of Forestry 8: 31-35.

An experiment was conducted at the Mesewam nursery of the Forest Research Institute of Ghana to examine the effect of cattle and poultry manure and NPK fertilizer on the growth performance of *Tectona grandis* seedlings. It was observed that except for number of leaves, growth media consisting of either cattle or poultry manure mixed with soil at a ratio 1:2 had a significantly better effect on growth than all the other treatments.

2270 Balagopalan, M. 1999. **Fertiliser recommendation for teak and eucalypt plantations**. Evergreen 43: 12-13. Kerala Forest Research Institute, Peechi.

From studies conducted at KFRI, recommendation is suggested for fertilizer application in teak and eucalypt plantations.

2271 Bale, A. 1977. **Effect of NPK fertilizers on yield of intercropped upland rice and growth rate of planted teak stands**. (Indonesian). Universitas Gadjah Mada, Yogyakarta: 15p.

2272 Barrett, R.L; Woodvine, F. 1971. **Possibilities for irrigated forestry in the Rhodesian Lowveld**. Rhodesian Forestry Commission, Forest Research Paper 1: 50p.

Tabulates data from 138 unreplicated trial plots of trees from 13 genera and 45 species including teak established since 1964 under irrigated conditions in this area of high average temperatures and low, erratic seasonal rainfall.

2273 Bhadran, C.A.R. 1959. **Irrigated teak plantations**. Indian Forester 85(6): 321-323.

Experiments undertaken to determine effect of irrigation on teak, best method of irrigation and optimum frequency, etc. Results indicate one irrigation of three hours once in fifteen days by percolation method gives best height growth.

2274 Bhat, K.M; Chacko, K.C; Balagopalan, M. 2001. **Evaluation of high input management on growth and timber production in teak**. KFRI Research Report 200. Kerala Forest Research Institute, Peechi.

Fertilization with irrigation had a significant effect on tree height and volume. Faster growth due to fertilization with irrigation in one-year-old seedlings increased the latewood width and fibre percentage resulting in higher density of wood.

2275 Bhatnagar, H.P; Gupta, B.B; Rauthan, B.S; Joshi, D.N. 1969. **Preliminary studies on the nutritional requirements of teak (*Tectona grandis*)**. Indian Forester 95(7): 488-495.

Nutrient solutions of N, P and K at 0, 340 and 680 mg./plant were applied to sand cultures. Data for height and weight increment and for chemical analysis of the seedlings are tabulated.

2276 Bheemaiah, G; Subrahmanyam, M.V.R; Ismail, S. 1997. **Performance of teak under different irrigation and fertilizer management practices**. Indian Forester 123(12): 1171-1175.

The treatments included three irrigation intervals of 10, 20 and 30 days and no irrigation control and four urea fertilizer application levels of 0, 100, 200 and 300 g/plant. Thirty months after planting, all the irrigation treatments had significantly influenced both the height and girth growth. Application of urea did not affect height and girth growth.

2277 Chakrabarti, C; Nashikkar, V.J. 1994. **Forest tree fertilization with sewage**. Bioresource Technology 50(3): 185-187.

A study was conducted in Nagpur to assess early growth response of some important forest tree species including *Tectona grandis* to sewage and sludge applications. Results showed that wastes had generally favourable effects on germination and early seedling growth of forest tree species.

2278 Coster, C. 1933. **Pilot tests in fertilising teak**. Tectona 26: p742.

2279 Coster, C. 1933. **Some orientating manuring experiments with teak**. (Dutch; English). Tectona 26(9): 742-762.

The manuring of forest crops vs. agriculture is discussed. Results indicate teak reacted favorably to manuring on extremely poor soils while on poor soils effect small or nil and super phosphate in extremely poor soils is more beneficial and agricultural taungya crop reacted quicker and better to manure.

2280 Drees, E.M. 1940. **Further results of some manuring experiments with teak**. (Dutch). Tectona 33: 591-606.

Applications of ammonium sulphate, potassium chloride and slaked lime had little or no beneficial effect upon the growth of teak. The effect of superphosphate varied widely on the different soils, and as knowledge of these is very scanty, field trials would be necessary to determine the effect of superphosphate on teak growth.

2281 Fagbenro, J.A; Agboola, D.A. 1993. **Effect of different levels of humic acid on the growth and nutrient uptake of teak seedlings**. Journal of Plant Nutrition 16(8): 1465-1483.

A greenhouse experiment to study the effect of humic acid on the growth and nutrient uptake of teak was conducted in Ibadan, Nigeria. The results indicated that humic

acid was beneficial to the growth and nutrient uptake of teak seedlings. A significant positive correlation was established between rate of humic acid application and plant height, stem diameter and total dry matter yield in the Oxisol.

2282 Fernando, S.N.U. 1966. **Fertilization of teak nurseries**. Ceylon Forester 7(3/4): 103-106.

Teak seedlings in a Ceylon nursery, showing deficiency symptoms were treated with N, P and K fertilizers; they responded well to applications of N in inorganic form.

2283 Fonseca Gonzalez, W. 2000. **The application of chemical fertilizers to *Tectona grandis* Linn.f. in Guanacaste, Costa Rica**. Taller de nutricion forestal memoria, 2 de junio, CONARE, San Jose, Costa Rica: 39-44. E. Chaves Salas; J.F di Stefano Gandolfi; M. Arguedas Gamboa; E.M. Guier Serrano; S. Rojas Soto, Eds. Consejo Nacional de Rectores, San Jose, Costa Rica.

The effects of fertilizing 6-month-old plantations of *Tectona grandis* in Costa Rica with different formulations of NPK were assessed by measuring survival, and relative height and diameter growth over 66 months after treatment. The fertilizer treatments had no effect on survival, and the best growth promoting treatments with more N or N and P contents generally producing the best results at Nandayure.

2284 Forest Department, Andhra Pradesh. 1964. **A note on manurial trials in teak plantation**. Andhra Pradesh Forest Department.

The effect of adding N, P and K on plant growth is discussed along with other trace elements in the soils. The details of treatments and method of manurial application are suggested.

2285 Forest Department, Sudan. 1952. **Use of ammonium sulphate to stimulate the growth of teak stumps**. Report of Forest Department, Sudan 1950-1951: 41p.

Ammonium sulphate was put in the planting holes in direct contact with the roots.

2286 Gawande, S.R. 1991. **Stand density manipulation and fertilisation studies on teak**. M.Sc Thesis: 81p. Kerala Agricultural University, Thrissur, Kerala.

2287 Gogate, M.G; Farooqui, U.M; Joshi, V.S. 1995. **Growth responses to irrigation: Eksal (Ambhadi) teak plantation - a case study**. Indian Forester 121(6): 491-502.

Application of irrigation and NPK fertilizer resulted in gains over rainfed plantations. Judicious application of irrigation and a greater emphasis on genetic improvement is recommended.

2288 Gogate, M.G; Farooqui, U.M; Joshi, V.S. 1995. **Sewage water as potential for the tree growth: A study on teak (*Tectona grandis*) plantation**. Indian Forester 121(6): 472-481.

The discharge of sewage water is a primary source of pollution, especially near big cities. In a case study of teak plantations irrigated with sewage at Dhule, W. Maharashtra, tree growth was significantly higher in plots irrigated with sewage water than in those irrigated with well water. The prospects of using sewage water for irrigation are discussed.

2289 Haque, M.S. 1996. **Intensive management of teak (*Tectona grandis*) plantations under irrigation on farm lands - some observations**. Indian Forester 122(7): 641-645.

The paper discusses the technical feasibility and financial viability of intensive, irrigated teak plantations, based on observations made in Periyar District, Tamil Nadu, in plantations financed both by banks and farmers' own resources.

2290 Hassan, M.M; Dey, H.B. 1979. **Studies on the nutritional requirements of forest trees - optimum NPK doses for teak seedlings**. Bano Biggyan Patrika 8(1/2): 57-63.

All possible combinations of N, P and K were applied to 6-wk-old seedlings growing in sand culture. Seedlings were also supplied with a solution of micro-nutrients for the duration of the experiment. Best growth was obtained with N, P and K at 250 mg/plant monthly, at which concentrations N and P contents were greatest.

2291 Jackson, J.K. 1973. **Some results from fertiliser experiments in plantations**. Federal Department of Forest Research, Nigeria, Research Paper Savanna Series 23: 21p.

Summarizes the results of experiments covering ten species including *Tectona grandis*.

2292 Jadhav, B.B; Kenjale, R.Y; Chavan, S.A. 1995. **Effect of growth regulators on performance of teak (*Tectona grandis*), laurel (*Terminalia tomentosa*) and khair (*Acacia catecheu*) un-**

der Konkan condition. Indian Forester 121(7): 667-669.

One year old seedlings of *Tectona grandis* were transplanted into lateritic soil and sprayed separately with gibberellin, NAA or IBA. Height and diameter growth were recorded.

2293 Joshi, V.S; Farooqui, U.M. 1997. **Irrigated teak plantations in Maharashtra - a case study**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 46-51. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

A study was undertaken to evaluate the performance of teak plantations raised on agricultural/forest lands under irrigated conditions in different parts of Maharashtra and the results are highlighted.

2294 Kaul, O.N; Gupta, A.C; Negi, J.D.S. 1972. **Diagnosis of mineral deficiencies in teak (*Tectona grandis*) seedlings**. Indian Forester 98(3): 173-177.

N, P, and K deficiency symptoms confirmed those previously reported for Teak. Deficiency symptoms occurred in the absence of Ca, Mg and S are discussed.

2295 Kaupenjohann, M; Zech, W. 1992. **Potassium requirements of fast-growing tropical tree plantations**. Potassium in ecosystems: Biogeochemical fluxes of cations in agro and forest systems. Proceedings of the 23rd Colloquium of the International Potash Institute, Prague, Czechoslovakia, 12-16 October 1992: 325-343. International Potash Institute, Basel, Switzerland.

A review is made of world literature on K nutrition of plantations of species including *Tectona grandis*.

2296 Khandwe, R; Sharma, R.C. 2003. **Effect of drip irrigation on growth and production of teak (*Tectona grandis*) in Satpura plateau of Madhya Pradesh**. Research on Crops 4(1): 114-116.

Teak plants with drip irrigation gave the highest plant height with 97 percent survival after one year in comparison with traditional irrigation method having 74 percent survival.

2297 Kishore, N. 1987. **Preliminary studies on the effect of phosphatic fertilizers on teak plantation**. Indian Forester 113(6): 391-394.

Treatments applied were Missouri phosphate, diammonium phosphate and single superphosphate. The results indicate that diammonium phosphate increased height growth and all other treatments except the 120 g dose of superphosphate.

2298 Masilamani, P; Annadurai, K; Chinnusamy, C. 2000. **Effect of macro and micronutrients spray on seedling growth attributes of teak (*Tectona grandis* Linn.f.)**. Madras Agricultural Journal 87(7/9): 529-530.

This study was conducted to determine the effect of macro and micronutrients on growth of teak. Treated with urea, DAP, zinc sulfate, borax, potassium sulfate, muriate of potash and water as control, applied by foliar spraying.

2299 Maun, M.M. 1977. **Survival and growth of four reforestation species applied with slow-release tablet fertilizer**. Sylvatrop 2(3): 219-222.

Seedlings of species including teak were planted at Nueva Viscaya, Philippines with or without the addition of one Agriform slow-release tablet fertilizer to the planting hole. Survival was not affected by the fertilizer treatment in any of the species.

2300 Mishra, K. 1995. **Enhancement of seedling growth by the application of potassium on *Tectona grandis* Linn.f. and *Dendrocalamus strictus* Nees**. Indian Journal of Forestry 18(4): 325-327.

Maximum growth enhancement was with the 1000 ppm treatment for *T. grandis*. Higher concentrations tended to reduce growth and cause the formation of pale green leaves.

2301 Mohan Kumar, B. 2003. **Sustainable teak plantations in the tropics: A question of nutrient management**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Sustainability of monocultural plantations, teak in particular, has been questioned recently, because of their adverse effects on soils. Summarise here the current state of knowledge on nutrient management of teak.

2302 Mutanal, S.M; Nadagoudar, B.S. 2003. **Intensive management of teak (*Tectona grandis*)**

plantation through fertigation. Indian Journal of Agricultural Sciences 73(6): 352-355.

Irrigation was provided to planted teak through drippers on alternate days. Biomass of teak increased 36 percent with fertigation in six splits as compared to two splits of fertigation. Fertigation resulted in a 33 percent saving in fertilizers.

2303 Mutanal, S.M; Prabhakar, A.S; Nadagoudar, B.S. 2000. **Fertigation and its influence on biomass and nutrient uptake in teak**. Karnataka Journal of Agricultural Sciences 13(3): 670-675.

A field trial on fertigation in teak was conducted in Karnataka using trickle irrigation. Uptake of nutrients was in order of N K P and increased with increase in levels of fertilizer dose. Total biomass of teak increased by 20 and 30 percent. Fertigation saved NPK by 33 percent compared to soil application.

2304 Mutanal, S.M; Prabhakar, A.S; Nadagoudar, B.S. 2000. **Fertigation studies in teak**. Karnataka Journal of Agricultural Sciences 13(4): 1036-1039.

An experiment was conducted at teak farm in Karnataka under drip irrigated conditions to investigate the effect of fertigation on the growth of teak.

2305 Mutanal, S.M; Prabhakar, A.S. 2001. **Growth and productivity of teak (*Tectona grandis*) under fertigation through drip irrigation system**. Indian Journal of Agricultural Sciences 71(6): 384-386.

Teak plants were supplied with different NPK fertilizer in a field experiment conducted in Karnataka. Plant height, diameter at breast height, basal area and volume values were measured. The interaction between fertigation rates and frequency was significant for plant height at 24 months and between diameter at breast height and volume at 28 months.

2306 Mutanal, S.M; Prabhakar, A.S; Nadagoudar, B.S; Mannikeri, I.M. 2001. **Growth pattern of teak under fertigation system**. Indian Journal of Forestry 24(3): 297-300.

Results of the experiment conducted on integrated nutrient management in teak through different levels and frequencies of fertigation are presented.

2307 Mutanal, S.M; Prabhakar, A.S; Nadagoudar, B.S. 2002. **Integrated nutrient management in teak through fertigation**. Indian Forester 128(3): 341-347.

An experiment was conducted on integrated nutrient management in teak through fertigation in Dharwad, Karnataka. Total biomass, height, diameter at breast height and basal area are increased by the fertigation.

2308 Nobuchi, T; Okada, N; Nishida, M; Siripatanadilok, S; Veenin, T; Tobing, T.L; Sahri, M.H. 2003. **Some characteristics of wood formation in teak (*Tectona grandis*) with special reference to water conditions**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Investigated the characteristics of wood formation in relation to water conditions. In Java islands, Indonesia, trees of 2 areas, Sukabumi and Cepu were compared. In Sukabumi that belongs to tropical rain forest area less distinct growth rings were observed than Cepu that has clearly dry season. Heartwood color also has the difference. In Malaysia growth rings of 14 years old plantation grown tree were investigated.

2309 Nwoboshi, L.C. 1973. **The effects of potassium supply on growth and nutrient composition of teak (*Tectona grandis*) seedlings**. Potassium in tropical crops and soils: Proceedings, 10th Colloquium, International Potash Institute, Abidjan: 513.

The dry weight of teak seedlings increased with increasing amounts of K applied as KNO_3 maximum at 109.2 p.p.m. and remained constant to 312 p.p.m. Foliar contents of Mg, Ca and P were reduced.

2310 Nwoboshi, L.C. 1984. **Growth and nutrient requirements in a teak plantation age series in Nigeria. II. Nutrient accumulation and minimum annual requirements**. Forest Science 30(1): 35-40.

Accumulation and annual requirements of N, P, K, Ca and Mg were calculated using bole, leaf and branch samples from trees. The proportions of all elements channelled to the foliage decreased, while those to the trunk and branches increased with age. Implications of this distribution and of harvesting intensity on site nutrient budgets are discussed.

2311 Ojo, G.O.A; Jackson, J.K. 1974. **The use of fertilizer in forestry in the drier tropics**. (French). Colloque international sur l'utilization des engrais en foret [FAO IUFRO International symposium on forest fertilization], Paris, France, 3-7 December 1973: 339-353. Ministere de l'Agriculture, Service des Forets, Paris, France.

In field trials, P often produces responses, response to N is often absent unless P is also applied. N sometimes increases growth during the wet season but causes reduced growth or mortality during the next dry season. Only a few cases of favorable response to K have been noted.

2312 Prasad, R; Sah, A.K; Bhandari, A.S. 1986. **Fertilizer trial in ten and twenty years old teak plantations in Madhya Pradesh**. Journal of Tropical Forestry 2(1): 47-52.

After five years, fertilizer treatment significantly increased height and d.b.h. in compared with controls and volume production in the 10-yr-old plantation.

2313 Raigosa, J; Ugalde Arias, L.A; Alvarado, A. 1995. **Initial response of *Tectona grandis* Linn.f. to fertilization with farmyard manure, ash, KCl and NPK in Guanacaste, Costa Rica**. Conference Proceedings of Seminario Technico Sobre Fertilizacion Forestal, Panama, 3 July 1995: 37-46. C.R.V. Osorio, Ed. CATIE, Panama.

2314 Rangaswamy, C.R; Jain, S.H; Sarma, C.R. 1990. **Effect of inorganic fertilizers on seedlings of casuarina, sandal and teak**. Myforest 26(4): 323-326.

Height, dry weight production and nutrient (NPK) analyses were carried out and found that the treatments increased growth and nutrient contents in casuarina and teak.

2315 Rangaswamy, C.R; Jain, S.H; Sarma, C.R. 1991. **Effect of inorganic fertilisers on seedlings of casuarina, sandal and teak**. Myforest 27(1): 35-38.

NPK fertilizer boosted the growth of seedlings of *Casuarina equisetifolia* and teak in polybags.

2316 Rawat, J.K. 1995. **Value of a 20-year old irrigated teak plantation**. Indian Forester 121(6): 553-557.

Growth and yield data for Indian teak plantations and prices and price trends for teak wood are used to estimate the value of a 20-year-old irrigated teak plantation.

2317 Roessel, B.W.P. 1936. **Fertilizing teak plantations**. (Dutch; English). Tectona 29(2/3): 83-100.

The author considers burning experiments in teak plantation sites gave same effect as manuring in poor sites, where silviculturally mixed plantations are not feasible. The author pleads for more comprehensive study of manuring vs. cost and profitability.

2318 Schnepper, W.O.R. 1934. **Application of artificial fertilizer to forest cultivation**. Tectona 27: 417-440.

2319 Siddappa Kannur; Devar, K.V. 2003. **Effect of fertilizers on the seedling growth of teak**. Myforest 39(2): 153-157.

2320 Singh, U; Gurumurti, K. 1984. **Oil cakes from oilseeds of forest origin - their potential as fertilizer**. Indian Journal of Forestry 7(1): 12-18.

Important and unexploited species producing oil-bearing seeds are listed and NPK contents of different cakes are estimated. Research has shown that diameter production in the first year of growth can be increased by more than 100 percent in *Tectona grandis* by application of different tree cake fertilizers.

2321 Subramanian, V; Rajendran, K; George, M. 1998. **Influence of bio-fertilizer and conservation of moisture on growth of young teak plantation**. (Indonesian). Advances in Forestry Research in India 19: 119-127.

A field experiment was conducted to investigate the effect of biofertilizers and coir pith on the growth performance of young teak plantation. It is suggested that application of biofertilizers along with mulch can be applied during the establishment phase of teak plantations to increase survival percentage as well as productivity.

2322 Sundralingam, P. 1982. **Some preliminary studies on the fertilizer requirements of teak**. Malaysian Forester 45(3): 361-366.

Teak seedlings in nursery seed beds at Kepong, Peninsular Malaysia, at 4 wk old showed deficiency symptoms which disappeared after fertilizing. Height and diameter growth responded well to NP treatments.

2323 Thaiutsa, B; Kaitpraneet, W; Suwannapinunt, W; Khemnark, C. 1976. **Responses of teak to nitrogen and phosphorus fertilization**.

(Thai). Faculty of Forestry, Kasetsart University, Thailand, Research Note 21: 14p.

10-yr-old teak trees were treated with ammonium phosphate at 2.1 kg/tree. After 1 yr there was no significant difference between treated and untreated trees in height, relative height or d.b.h. increments. Thinning, rather than fertilizing is recommended for enhancing the diameter growth of teak in the early growing period.

2324 Torres, S; Marquez, O; Hernandez, R; Franco, W. 1993. **Initial growth response of teak to phosphorus in the western plains of Venezuela**. (Spanish). Turrialba 43(2): 113-118.

Analysed the effect of rock phosphate fertilizer on the growth of 2-, 7- and 12-year-old teak plantations on alluvial soils. On sites with moderate drainage, the 2-year-old plantations showed a significant response in both diameter and height growth to the fertilizer. The role of Ca in the observed response is discussed.

2325 Wang, B.G; Lu, L.H. 1996. **Soil nutrition condition and its management in the nurseries of Guangxi Daqingshan Mountain**. Forest Research 9(4): 403-408.

Investigations were made in nurseries growing seedlings of species including *Tectona grandis*.

Go top

Agroforestry

(See also 0096, 2872, 3506)

2326 **Reproduction of teak by means of taungyas**. Indian Forester 24(2), 1898: 62-66.

Details of teak regeneration under taungya system and remarks on Tharrawaddy taungyas are given.

2327 **Underplanting experiments of teak in Madras**. Forest Research in India, 1930: p85.

2328 **The influence of agricultural crops in taungya plantations on the growth of teak**. Indian Forester 62(10), 1936: 661-662.

Taungya cultivation is generally considered harmful and recommends studies on retarding effect of taungya crops due to shade and root competition on teak.

2329 **The effect of different Kumri crops on teak**. Forest Research in India and Burma Part II, 1947: p53.

Field crops like hill paddy, chillies and ginger are found to have significant effect on growth of teak.

2330 **Effect of different kumri crops on teak raised with them**. Forest Research, India and Burma 1948/49, Part. I, 1952: p37.

The field crops like paddy, chillies, cotton, millet, tapioca, horse gram, and ginger are found grown along with teak without causing significant loss in height growth. Maize reduce height growth of teak.

2331 **Leguminous creepers in younger teak plantations**. Forest Research in India Part II, 1951-52, 1952: p38.

The effect of leguminous creepers like *Centrosoma pubescens, Pueraria javanica* and *Calapogonium* species on the growth of teak is studied and found that it retarded the growth of teak.

2332 **Report on Madagascar**. (French). Proceedings of the First Conference on Forestry Inter African Countries, Abidjan, 1951, 1952: 521-544.

The topography, agriculture practices and general lack of control make forestry worse in this country. The effect of having forests at the mercy of local interests is emphasized. Teak is considered as one of the species to be used for planting.

2333 **Teak plantations with kumri crop**. Forest Research in India Part II 1954-55, 1955: p74.

It is reported that there is no difference in the growth of teak raised with common Kumri crops like hill paddy, chillies, cotton, ragi, tapioca and horse gram.

2334 **Teak: Underplanting**. Forest Research in India, 1955.

Underplanting is observed to reduce diameter increment of teak though not significantly.

2335 Aguirre, A. 1963. **Silvicultural and economic study of the taungya system in the conditions of Turrialba**. (Spanish). Turrialba 13(3): 168-171.

Survival and growth of teak and some other trees planted with agricultural crops and without agricultural crops at 6 months and establishment costs are compared. *Tec-*

tona grandis and *Cordia allidora* appear suitable for reforestation.

2336 Alexander, T.G; Shobhana, K; Balagopalan, M; Mary, M.V. 1980. **Taungya in relation to soil properties, soil erosion and soil management**. KFRI Research Report 4: 24p. Kerala Forest Research Institute, Peechi.

Agrisilvicultural practices in relation to soil properties, soil erosion and soil management was taken up with the objectives of evaluating changes in soil properties due to taungya practices, assessing the extent of soil erosion in taungya plantations and improving the management of soils during the first two years of forest plantations.

2337 Allan, C.W. 1916. **Teak taungya plantations in the Henzada-Maupin Division**. Indian Forester 42(11/12): 533-537.

The taungya method of raising teak plantations is described together with details of method and costs.

2338 Alphen de Veer, E.J Van. 1957. **Teak cultivation in Java**. Tropical Silviculture 2, FAO Forest and Forest Products Studies 13: 216-232.

Describes the method of artificial planting of teak under taungyas and underplanting with *Leucaena glauca*. Teak forests are found on margalite soils of tertiary origin, in the low land upto 500m. above sea level in islands of Java and Muna.

2339 Alrasjid, H. 1985. **Plantation trial of ebony (*Diospyros celebica*) under a teak stand in Java**. Buletin Penelitian Hutan, Pusat Penelitian dan Pengembangan Hutan 464: 23-37.

Growth data showed a large variation which was attributed to differential soil fertility.

2340 Arifin, M. 1983. **Enlargement of planting space in intercropping system**. (Indonesian). Duta Rimba 9(57/58): 24-26.

An increase in spacing was tested in intercropping trials with food crops in Indonesia.

2341 Aung Thant Zin, U. 2004. **A teak based multistoried agroforestry system**. TEAKNET Newsletter 32: p6.

Discussed the achievement made by the ITTO project implemented by the Forest Department of Myanmar.

2342 Bale, A. 1980. **The development of teak plantation under taungya system in Java**. Gadjah Mada University, Yogyakarta, Indonesia.

2343 Bale, A. 1981. **Intensification trials of the taungya system in teak forests on Java**. Observations of agroforestry on Java, Indonesia. Report on an agroforestry course, Forestry Faculty, Gadjah Mada University, Yogyakarta: 97-104. K.F. Wiersum, Ed. Department of Forest Management, Agricultural University, Wageningen, Netherlands.

Use of various dryland rice varieties for interplanting and the effect of fertilizing is studied.

2344 Baminiwatte, A.N.S. 2003. **An appraisal of teak farmer's woodlots in Sri Lanka and the relevant management strategies**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Based on the experiences gathered from the previous and the present agroforestry programmes, discusses the problems associated with managing the farmer's woodlots and recommends measures for improved management.

2345 Bhatia, K.K. 1958. **A mixed teak forest of Central India**. Journal of Ecology 46(1): 41-63.

Analysis of the vegetation of a mixed deciduous teak forest at Sagar, Central India revealed four forest types which include mixed *Tectona grandis*. Soils under each subtype and regional ecological factors were studied. The present mixture of types is due to the heterogeneity of environmental factors, the absence of species able to cover the whole range of habitats, seral development and the adjustment of plants to biotic pressure. Successional trends are indicated.

2346 Bhople, R.S; Shinde, P.S; Marawar, S.S; Zade, U.B. 1999. **Constraints faced by growers in use of recommended practices of teak**. Indian Journal of Forestry 22(1/2): 145-148.

Farmers in Akola District, Maharashtra have been planting commercial teak on their land as part of a social forestry programme. Constraints felt by the farmers in adopting teak planting are listed and briefly discussed. Appropriate improvements are suggested.

2347 Boonkird, S. 1978. **Taungya system: Its applications, ways and means of improvement in Thailand**. Proceedings of the 8th World Forestry Congress, Jakarta, 16-28 October 1978, World Forestry Congress: Forestry for Food FFF-7-5: 18p.

A description of the forest village system for cultivating teak with farm crops in between is given.

2348 Braat, C.G.S. 1912. **Underplanted crop *Leucaena glauca***. Tectona 5: 522-523.

2349 Bryant, R.L. 1994. **From laissez-faire to scientific forestry: Forest management in early Colonial Burma 1826-85**. Forest and Conservation History 38(4): 160-170.

Laissez-faire practices allowed widespread over harvesting of teak after British colonization of the province of Tenasserim in Burma. This practice was widely criticised, and following the second Anglo-Burmese war resulted in the creation of the Burma Forest Department in 1856. An account is given of the taungya system introduced by the Forest Department for promoting cooperation with local forest users.

2350 Bryant, R.L. 1994. **Shifting the cultivator: The politics of teak regeneration in colonial Burma**. Modern Asian Studies 28(2): 225-250.

Examines the use of the taungya system for teak regeneration in Burma as a means of political and economic control of the shifting cultivation system of the hill karen.

2351 Bryant, R.L. 1994. **The rise and fall of taungya forestry: Social forestry in defence of the empire**. Ecologist 24(1): 21-26.

The development of the taungya system of agroforestry by the British in the teak forests of Burma is discussed in relation to interaction and tensions between the British government's forestry service and the shifting cultivators who inhabited the forests, its effectiveness as a sustainable forestry system compatible with shifting agriculture and the likelihood of similar social tensions in its application today.

2352 Buvaneswaran, C; George, M; Manivachakam, P; Subramanian, V. 2001. **Comparative studies on performance and productivity of teak (*Tectona grandis* Linn.f.) in farmland and in forest plantation**. Range Management and Agroforestry 22(1): 113-117.

Teak plantations grown in a farmer's field were studied and compared with a 20-year-old teak plantation grown in a forest land in Coimbatore, Tamil Nadu.

2353 Carpenter, P.H. 1929. **Tea in North East India**. Agriculture Journal India, Calcutta 24:p 52.

Report on the insect *Zeuzera coffeae* which attacks tea and teak.

2354 Chandrashekara, U.M. 1996. **Ecology of *Bambusa arundinacea* (Retz.) Willd. growing in teak plantations of Kerala, India**. Forest Ecology and Management 87(1/3): 149-162.

A study was undertaken to assess the contribution of bamboo to the vegetation structure, biomass productivity and nutrient cycling in teak plantations in the Kariem-muriem Forest Range, Kerala. From the nutrient conservation and cycling point of view, teak is find suitable in moderately bamboo rich area and bamboo poor area.

2355 Chandrashekara, U.M. 1996. **Ecological studies on *Bambusa arundinacea* (Retz.) Willd. growing in teak plantations of Kerala, India**. KFRI Research Report 107: 33p. Kerala Forest Research Institute, Peechi.

A study was undertaken to assess the contribution of bamboo to the vegetation structure, biomass productivity and nutrient cycling pattern in 15-20 year old teak plantations of Kariem-muriem Forest Range, Kerala. The results show that from the nutrient conservation and cycling point of view teak is find suitable for moderately bamboo rich area and bamboo poor area.

2356 Chandrashekara, U.M. 1996. **Studies on growth and architecture of tree species of home garden agroforestry systems of Kerala**. KFRI Research Report 101: 38p. Kerala Forest Research Institute, Peechi.

Characters such as crown architecture, growth, leaf phenology and branching pattern were studied in nine forest trees which include teak growing in home gardens in Panancherry Panchayat, Kerala, with a view to assessing their suitability as components in home garden agroforestry systems.

2357 Chandrashekara, U.M. 1997. **Growth and architectural analysis of trees of agroforestry importance in Kerala**. Range Management and Agroforestry 18(2): 151-163.

Characters such as crown architecture, growth and branching pattern were studied in nine forest tree species including *Tectona* *grandis* grown in home gardens in Panancherry Panchayat, Kerala, with a view to assessing their suitability as components in home garden agroforestry systems.

2358 Chantraprapa, S; Eiumnoh, A. 1991. **Agroforestry of Klang-Dong forest station**. International Workshop on Conservation and Sustainable Development, 22-26 April 1991, AIT-Bangkok and Khao Yai National Park, Thailand: 369-371. Asian Institute of Technology, Bangkok.

A brief account is given of the introduction of agroforestry techniques into a reforested area of the Dong Phaya Yen National Forest Reserve at Klang-Dong, Thailand. A scheme involving intercropping of food crops in the teak plantations was set up. Brief details are given of management, economic and social aspects of the scheme, and of problems which have occurred.

2359 Clifford, J.D. 1917. **Formation of teak taungya plantations in Burma**. Indian Forester 43(3): 117-121.

The method of counting seedlings is critically examined and a note is added on the size and method of teak taungyas.

2360 Clubbe, C.P; Jhilmit, S. 1994. **The potential of the forestry sector as a contributor to sustainable agriculture**. Proceedings of the 6th Annual Seminar on Agricultural Research (Sustainable Agriculture), Trinidad and Tobago, 3-4 November, 1992: 135-146.

2361 Coster, C. 1939. **Grass: Teak taungya plantations**. Indian Forester 65(3): 169-170.

Experience of teak taungyas in Java showed that teak is susceptible to root competition especially to grass and to prevent grass growth, interculture of alternate lines of *Leucaena glauca* is recommended.

2362 Coster, C; Kardjowasono, M.S. 1935. **The influence of agriculture crops in taungya plantations on the growth of teak**. (Dutch; English). Tectona 28(6): 464-487.

The taungya method of teak cultivation and various experiments on different agricultural crops are described. The growth of teak with reference to effect of agricultural crops and *L. glauca* are discussed.

2363 Dagar, J.C; Singh, G; Singh, N.T. 1995. **Evaluation of crops in agroforestry with teak (*Tectona grandis*), maharukh (*Ailanthus excelsa*) and tamarind (*Tamarindus indica*) on reclaimed salt affected soils**. Journal of Tropical Forest Science 7(4): 623-634.

To identify suitable crops for growing in interspaces of plantations including teak on reclaimed salt affected soils, various combinations of crops were examined. A reduction in yield of all the crops interplanted in the plantations is reported.

2364 Daradi, R.B. 1980. **The effect of intercropping of ipil-ipil (*Leucaena glauca*) on teak**. (Indonesian). Gema Rimba 6(41/42): 53-55.

2365 Dauget, J.M; Dupuy, B; N'Guessan, A. 1990. **An architectural analysis of a mixed plantation of samba and teak**. (French). Bois et Forests des Tropiques 224: 21-26.

A method of assessing stand structure using profiles to complement quantitative tree data is presented.

2366 Dawkins, C.G.E. 1922. **Big Hnaw (*Adina cordifolia*) and teak trees**. Indian Forester 48(2): 108-110.

From Zigon Division of Burma a big teak tree measuring 18'2" girth c.b. at b.h. with an yield of 957.1 cu.ft. was reported.

2367 De, R.N. 1938. **Effect of grass on teak seedlings**. Indian Forester 64(9): 563-564.

In Goalpara Division, Assam, grass is observed to slow down growth of teak seedlings.

2368 Deventer, A.J van. 1913. **Mixtures in teak forests**. (Dutch; English). Tectona 6: 273-293.

2369 Dhanda, R.S; Sidhu, D.S. 2003. **Prospects and potential of growing teak in agroforestry in Punjab**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

The growth performance of the trees planted have been measured and estimated their timber volume. The information derived prompts the authors for successful cultivation of teak in some parts of the state. Plantation strategies on farm border rows and farm steads in agrisilviculture systems for adoption by the farmers have been discussed. The aftercare and management strategies to protect teak trees from frost damage in early stages, fire and wind damage have been mentioned. Future scope and suitable extension strategies for quality teak plantations in the north-western states of India have been elaborated.

2370 Drees, E.M. 1949. **Bordered trial plots for testing the influence of interplanted rows of green-manuring crops in teak forests**. (Dutch). Tectona 39(4): 302-312.

Use of bordered plots for planting is explained which consist of a central plot bordered by a border plot, the two plots are separated by an insulation or buffer strip.

2371 Eidmann, F.E. 1932. **Underplanting in teak plantations**. (Dutch; German). Tectona 25(4): 671-690.

2372 Forest Department, Madras. 1942. **On underplanting teak**. Annual Report of Silvicultural Research in the Madras Presidency for year 1940-41: p85; 28.

It has been shown that *Swietenia macrophylla* and *Cedrela toona* can be successfully underplanted under quality teak of about 37 years of age if plants are introduced in dense lines in order to reduce browsing damage.

2373 Forest Department, Maharashtra. 1949. **Bamboo growth outting in teak plantations**. Annual report, Silviculture Research, Bombay state 1948-49.

Cutting bamboo in July and regrowth clearance in August has given encouraging results in Kanara district of Mysore.

2374 Gajaseni, J. 1990. **Diversified agroforestry system**. Symposium on agroforestry systems and technologies, Bogor, Indonesia, 19-21 September 1989. BIOTROP-Special-Publication 39: 157-161. C.F. Jordan; J. Kartasubrata; S.S. Tjitrosomo; R.C. Ummaly, Eds.

A brief account is given of a further development of the Thai forest village system, in which teak is planted at wider spacings and interplanted both with other forest trees and with agricultural crops.

2375 Gajaseni, J; Matta Machado, R. 1996. **Diversified agroforestry systems: Buffers for biodiversity reserves, and land bridges for fragmented habitats in the tropics**. Biodiversity in managed landscapes: Theory and practice: 506-513. C.F. Jordan; R. Szaro; D.W. Johnston; L. Umans, Eds. Oxford University Press, New York .

A short discussion, with an outline of a case study in Thailand, in which an experimental taungya system was used to improve the biodiversity by planting fruit trees after the grain crop in a teak plantation.

2376 Gonggrijp, L. 1928. **Artificial mixing of Tectona with other species**. (Dutch; English). Tectona 21: 774-794.

Roosendael report on mixed teak plantations suggests that in good soil areas suitable for planting teak, less costly measures to safeguard soil and also increase proportion of teak for better and increased output from these plantations.

2377 Gonggrijp, L. 1929. **International artificial mixing of teak and other timber species**. (Dutch; English). Tectona 22: 2187-2194.

2378 Gowri, K.V; Subrahmanyam, M.V.R; Bheemaiah, G. 2000. **Influence of leguminous and non-leguminous tree species on yield and economics of rainfed groundnut under nitrogen and phosphorus fertilization**. Indian Journal of Agricultural Sciences 70(6): 413-415.

In a field groundnuts were grown alone or alley cropped between *Albizia lebbeck* or *Tectona grandis* trees and were given fertilizers. Net returns and benefit:cost ratio were highest in pure stand and increased with fertilizer application.

2379 Granert, W.G; Cadampog, Z. 1980. ***Leucaena* as a nurse tree**. Leucaena Newsletter 1: p21.

Stems were straighter with less branching on plots with nurse trees.

2380 Gupta, R.K. 1993. **Multipurpose trees for agroforestry and wasteland utilisation**. 562p. Oxford & IBH Publications, New Delhi.

Introduction part gives an overview of the use of multipurpose trees in environmental protection, for the rehabilitation of waste lands and by small and marginal farmers and the landless. The major section discusses multipurpose trees in relation to the ecological regions of India, delineating the major phytogeographical zones and their vegetation types and listing and describing the various agroforestry systems utilizing multipurpose trees in the different regions of the country. Part two gives the descriptions of different multipurpose trees which include *Tectona grandis* and references are given after each species description as well as at the end of the book.

2381 Haque, M.S; Osman, K.T. 1993. **Performance of gurjan (*Dipterocarpus turbinatus*) and teak (*Tectona grandis*) in pure and mixed plantations at Kaptai, Bangladesh**. Indian Forester 119(9): 738-743.

Greater diameter of teak in the mixed plantation is reported. The mixed species site had a higher moisture content, and this is suggested as a possible reason for better teak growth.

2382 Hart, H.M.J. 1931. **Mixed teak plantations-Two parts**. (Dutch; English). Tectona 24: 88; 488-511.

2383 Heringa, P.K. 1929. **The introduction of *Biza orellana* Linn. as under-growth in teak forests**. Tectona 22: 263-267.

2384 Jimenez, M; Rodriguez, A; Montalvo, J.M; Alvarez, L. 1988. **Evaluation of *Coffea arabica* in association with forest trees on terraces in the Sierra del Rosario, Pinar del Rio, Cuba**. (Spanish). Revista Forestal Baracoa 18(1): 65-78.

Coffee yields were measured after 15 years in association with different species including *Tectona grandis*. Highest yields were with *T. grandis*. Growth of *T. grandis* was not affected by the presence or absence of coffee.

2385 Jordan, C.F; Gajaseni, J. 1990. **Interplanting of *Tamarindus indica* L. in teak plantations**. Fast growing trees and nitrogen fixing trees: International Conference, Marburg, 8-12 October 1989: 76-81. D. Werner; P. Muller, Eds. Gustav Fischer, Stuttgart, Germany.

In the Forest Village System of Thailand taungya is practised in teak plantations interplanted with *Tamarindus indica*.

2386 Joshi, M.D. 1967. **Cultivation of *Rauwolfia serpentina* as an intercrop in teak plantations**. Proceedings of the 11th Silvicultural Conference, Dehra Dun Item V B. Forest Research Institute, India.

The desirability of cultivation of *Rauwolfia* in an intensive manner as an intercrop in teak planting is discussed. It is considered as very economical. The paper describes briefly the method of cultivation, expenditure incurred etc. and yield.

2387 Kapp, G. 1988. **The forest-village model of the Thai state**. (Thai; English). Plant Research and Development 27: 8-11. Translated from Allgemeine Forstzeitschrift 42, 1986: 1064-1065.

As a consequence of population growth and immigration, agriculture in Thailand has expanded at the expense of forests. A project to combat this trend is the forest village programme initiated by the Thai Forest Industry Organisation. An afforestation programme is carried out under this programme.

2388 Kapp, G.B; Beer, J; Lujan, R. 1997. **Species and site selection for timber production on farm boundaries in the humid Atlantic lowlands of Costa Rica and Panama**. Agroforestry Systems 35(2): 139-154.

The CATIE-GTZ Agroforestry Project set up experiments with five timber tree species including teak planted in twelve farm boundaries in Costa Rica and Panama in cooperation with local farmers. In view of these excellent growth rates, planting of *Cordia alliodora*, *Eucalyptus deglupta* and *Tectona grandis* in lines on farm boundaries is recommended.

2389 Kerbert, H.J. 1904. **The cultivation of teak in connection with edible rice**. Journal Industry and Agriculture.

2390 Kerbert, H.J. 1908. **An observation with interplanting with *Leucaena glauca***. Tectona 1: p336.

2391 Kermode, C.W.D. 1939. **Mixtures in plantations Paper II**. Proceedings of the 5th Silvicultural Conference, Dehra Dun: 362-372. Forest Research Institute, Dehra Dun.

Presents an account of experimental mixtures of teak with cutch and *Xylia dolabriformis* followed in Burma.

2392 Kermode, C.W.D. 1952. **The use of taungya in natural regeneration operations**. Burmese Forester 2(2): 65-70.

Examples are described from dry teak forest and eastern laterite evergreen.

2393 Koppikar, V.B. 1950. **Some observations on mixed planting of *Ocimum kilimandscharicum* (camphor-yield Tulsi plant) and young teak**. Indian Forester 76(9): p405.

It is suggested that the highly aromatic *Ocimum* has a toxic effect on very young teak.

2394 Krishnaswamy, V.S. 1956. **Cover and nurse crops in sal (*Shorea robusta*) and teak (*Tectona grandis*) plantations at Dehra Dun**. Indian Forester 82(4): 153-170.

Describes a series of investigations to determine the practicability of improving and accelerating the establishment of sal and teak plantations on exhausted agricultural land by the use of nurse and cover crops.

2395 Kumar, B.M; Kumar, S.S; Fisher, R.F. 1998. **Intercropping teak with *Leucaena* increases tree growth and modifies soil characteristics**. Agroforestry Systems 42(1): 81-89.

The effects of intercropping with *Leucaena leucocephala* on early teak growth and soil properties in a simulated taungya system were evaluated in a humid tropical region in central Kerala. Teak growth increased with increasing relative proportion of *Leucaena* in the mixture.

2396 Kushalappa, K.A. 1982. **Teak underplanting**. Myforest 18(4): 159-161.

A brief account of teak underplanting in the open deciduous forests of Karnataka.

2397 Lahiri, A.K. 1972. **Intercropping trials with turmeric in North Bengal**. Indian Forester 98(2): 109-115.

Data shows that turmeric improving the growth of the forest crop. Recommendations are made on site preparation, planting, spacing, weeding and earthing, time of harvesting and control of diseases and pests. It is concluded that intercropping with turmeric can be a substantial source of extra income in forest plantations.

2398 Lahiri, A.K. 1987. **A note on prospects of *Tectona grandis* and *Xylia dolabriformis* mixture in North Bengal**. Indian Journal of Forestry 10(3): 232-233.

A mixed plantation was established in West Bengal. It is suggested that *X. dolabriformis*, which is fire resistant like teak is a suitable species for growing with teak in the region.

2399 Lahiri, A.K. 1989. **Taungya based agroforestry trials in West Bengal**. Indian Forester 115(3): 127-132.

An account of research on the taungya system in West Bengal since 1965 is given. The effect of spacing on the growth of teak with and without intercrops, sequential cropping, the effect of plantation age on the yield of various intercrops and the growth of the forest species under these conditions, the performance of a 3-tier cropping systems, etc. are discussed.

2400 Lal, A.B. 1942. **Significance of teak-sal mixture from the standpoint of plant succession**. Indian Forester 68: 181-187.

In the Kanker range the mixture is rare since teak tends to be suppressed by sal. It is argued that this is due to the silvicultural characters of sal, including shade tolerance and relatively better growth, as well as to local site conditions, which are more favourable to sal than to teak.

2401 Lamb, A.F.A. 1955. **Forestry on private estates**. Journal of the Agricultural Society of Trinidad and Tobago, Port of Spain 55(2): 169-183.

Discusses the long-term prospects of growing timber trees including teak for profit on sites unsuitable for plantation crops, with information on site requirements, propagation, protection and uses.

2402 Laurie, M.V. 1939. **Mixtures in plantations**. Proceedings of the 5th Silvicultural Conference, Dehra Dun: 349-362. Forest Research Institute, Dehra Dun.

Discusses the possibilities of raising teak in mixtures with nine other timber species and bamboos.

2403 Leete, F.A. 1912. **Pyinmana Forest Division: Teak and bamboos in Burma**. Indian Forester 38(8): p583.

It is suggested that exploitation plans of teak should take into consideration bamboo flowering.

2404 Leete, F.A. 1912. **Pyinmana forest division: Teak and bamboos in Burma**. Indian Forester 38: 249-255.

Importance of bamboo flowering *vis a vis* natural regeneration and exploitation of teak in Burma.

2405 Lottie. 1919. **A plea for teak taungyas**. Indian Forester 45(1): 6-10.

In view of the predominance of teak in unclassed forests and unreserves, the author considers taungya system is more suitable to Burma conditions.

2406 Macedo, R.L.G; Venturin, N; Gomes, J.E; Oliveira, T.K de. 2002. **Dynamics of establishment of *Tectona grandis* Linn.f. associated with coffee plantations in Brazil**. (Portuguese). Brasil Florestal 21(73): 31-38.

No significant difference found for the spacings studied. The results suggest that teak plantlets should be rooted first and planted one year before or at the same year the coffee trees are planted.

2407 Madiwalar, S.L; Nadagoudar, B.S; Mutanal, S.M. 1996. **Economic evaluation of an agri-silvi-horti-pastoral system in transitional tract of Dharwad**. Proceedings, IUFRO-DNAES International Meeting: Resource inventory techniques to support agroforestry and environment, Chandigarh, 1-3 October 1996: 287-289. S.J. Patil; R.K. Kohli; K.S. Arya; Atul, Eds. HKT Publications, Chandigarh.

Economic analysis indicated that growing of teak, papaya and pasture crops gave higher annual net returns compared with growing only arable crops. Inclusion of teak and papaya with arable crops resulted in the highest average annual net returns.

2408 Maldonado, G; Louppe, D. 1999. **Teak from farmers plantations in Cote d'Ivoire**. (French). Bois et Forests des Tropiques 262: 19-30.

Teak has been planted in rural areas since its introduction in 1929 in Cote d'Ivoire. These plantations are scattered and mostly established on a small scale. The teak plantations provide a significant income for many farmers.

2409 Mathur, A.K. 1951. **The problem of underplanting in teak plantations of Nilambur**. Madras Forest College Magazine 27(3): 132-140.

The problem of raising pure teak plantations is discussed with reference to deciduous habit of teak, soil and rainfall conditions. The experiments in Madras forest department on this problem and underplanting teak with suitable species so as to provide soil cover is discussed. Some species found good for the purpose are listed.

2410 McCrie, C.M. 1908. **Mixed teak forests of Saugor Division, Central Provinces**. Nagpur Forest Officers Conference, Nagpur.

2411 MeCrie, C.M. 1909. **Mixed teak forests of Saugor division and their treatment**. Indian Forester 35(10): 553-560.

The Vindhyan mixed teak forests, its present condition, problems of exploitation and natural regeneration are discussed. The forests are worked under coppice and improvement fellings and the problems of natural regeneration by coppice and seed are discussed.

2412 Milde, R de; Ahmad, I.U. 1985. **The mixed hardwood, teak plantation in Chittagong Hill Tracts**. FAO/UNDP Project BGD/79/017.

2413 Mishra, J; Prasad, U.N. 1980. **Agri-silvicultural studies on raising of oil seeds like *Sesamum indicum* Linn. (til) *Arachys hypogea* Linn. (groundnut) and *Glycine* max Merrill. (soybean) as cash crops in conjunction with *Dalberiga sissoo* Roxb. and *Tectona grandis* Linn.f. at Mandar, Ranchi**. Indian Forester 106(10): 675-695.

Results of a taungya agroforestry project on a clear-felled sal forest site in Bihar are reported. Soil N and P increased after all crops but K decreased. Height of both trees was n.s.d. with and without intercropping.

2414 Misra, K.K; Rai, P.N; Jaiswal, H.R. 1994. **Survival and growth of four tree species inter cropped with wheat-paddy rotation**. Indian Forester 120(8): 745-747.

One-year-old seedlings of *Eucalyptus hybrid* , *Bombax ceiba* and *Tectona grandis* and cuttings of *Populus deltoides* were planted at the Horticulture Research Centre at Pantnagar, Uttar Pradesh. Plots were intercropped with a wheat-paddy rotation. Data are tabulated on tree survival and growth.

2415 Mittelman, A. 2000. **Teak planting by smallholders in Nakhon Sawan, Thailand**. Unasylva 51(201): 62-65.

An agroforestry and community forestry project in Thailand has encouraged small farmers in teak planting.

2416 Mutanal, S.M; Nadagoudar, B.S; Patil, S.J. 2001. **Economic evaluation of an agroforestry system in hill zone of Karnataka**. Indian Journal of Agricultural Sciences 71(3): 163-165.

The results of an experiment involving arable crops, silvicultural trees, horticultural crops and pasture grass, conducted in black clayey soils in Dharwad, Karnataka was used for an economic evaluation.

2417 Mutanal, S.M; Prabhakar, A.S; Nadagoudar, B.S. 2000. **Groundnut (*Arachis hypogaea*)-teak (*Tectona grandis*) interaction in agroforestry system**. Indian Journal of Agricultural Sciences 70(7): 463-465.

In the agroforestry system, light transmission was decreased and the groundnut yield was also decreased. Soil pH and EC decreased with inclusion of teak with groundnut, while available N, P and K increased.

2418 Mutanal, S.M; Prabhakar, A.S; Madiwalar, S.L. 2000. **Growth pattern of groundnut in teak based agroforestry system**. Karnataka Journal of Agricultural Sciences 13(4): 1033-1035.

Taller plants were observed on the western side of teak rows compared with the eastern side of the teak alley. Height reduction was observed in plants that were 1 and 5 m away from teak trees.

2419 Mutanal, S.M; Prabhakar, A.S; Nadagoudar, B.S. 2000. **Growth pattern of sorghum in association with teak based agroforestry systems**. Karnataka Journal of Agricultural Sciences 13(4): 925-927.

An experiment involving sorghum, teak and guinea grass and subabul was initiated in Karnataka to determine the growth pattern of sorghum with teak in agroforestry systems. A significant percentage reduction of plant height was observed in 30, 60, 90 days after sowing and at harvest.

2420 Mutanal, S.M; Prabhakar, A.S. 2000. **Performance of groundnut in teak based agroforestry systems**. Karnataka Journal of Agricultural Sciences 13(4): 919-924.

A long-term field experiment involving groundnuts, teak, guinea grass and subabul was initiated in Karnataka to assess the suitability of groundnut in teak-based agroforestry system. A significant yield reduction resulted when groundnut was intercropped with teak, teak+guinea grass and teak+subabul.

2421 Mutanal, S.M; Prabhakar, A.S; Nadagoudar, B.S. 2001. **Compatability of sorghum (Sorghum bicolor) in teak (*Tectona grandis*)-based agroforestry system**. Indian Journal of Agricultural Sciences 71(3): 197-200.

A field experiment involving teak and pasture crops and subabul was conducted on red gravelly soils in Dharwad, Karnataka to determine the compatibility of associated sorghum. Grain yield was the highest with sole sorghum as compared to sorghum with teak, teak + grass and teak + subabul. Grain and straw yield of sorghum was reduced significantly nearer to the teak valley.

2422 Mutanal, S.M; Prabhakar, A.S; Nadagouda, B.S. 2001. **Performance of teak in silvi agri pastoral system**. Karnataka Journal of Agricultural Sciences 14(1): 179-181.

A field experiment was conducted involving sorghum and groundnut, teak, pasture crops on red gravelly soils in Karnataka to study the performance of teak under different agroforestry systems. Growth of teak was compared based on height, diameter at breast height, basal area and marketable timber.

2423 Mutanal, S.M; Prabhakar, A.S; Nadagoudar, B.S. 2002. **Economic viability of teak based agroforestry system**. Karnataka Journal of Agricultural Sciences 15(3): 543-544.

2424 NABARD. 2002. **Model project on growing teak under farm forestry**. NABARD.

2425 Nadagouda, V.B; Radder, G.D; Patil, C.V; Manjappa, K; Desai, B.K. 1996. **Performance of groundnut in alley cropping under irrigation in north eastern dry zone of Karnataka**. Indian Journal of Soil Conservation 24(2): 132-136.

A field experiment was conducted to study the effect of seven tree species on the associated groundnut crop under irrigation in Karnataka. All the tree species including teak are found to have adverse effect on the pod yield of groundnut.

2426 Nair, P.N. 1980. **Vanalakshmi, an agroforestry project in Kerala**. Indian Forester 106(12): 829-836.

A scheme is described for the introduction of pepper, cocoa and medicinal plants as undercrops in plantations of teak, *Grevillea robusta*, *Bombax* spp. and *Artocarpus hirsutus* in an effort to reduce the loss of forest land to agriculture. Initial results are promising and an internal rate of return of 15 percent is anticipated.

2427 Nakashima, K. 1994. **Development of techniques for the utilization of environmental resources and perspective of promotion of research in the marginal land area 2. Degraded forest lands in the tropics and agroforestry - analysis of light conditions under a canopy of fast-growing trees**. JIRCAS Workshop Papers 2: 4-16.

Light quality and quantity were analysed under tree canopies of about fifty tree species including *Tectona grandis* in order to study its effect on the production of agricultural crops in agroforestry systems.

2428 Ojechomon, O.O. 1963. **Ecological studies on some teak (*Tectona grandis* Linn.f.) planta-**

tions in Nigeria. University Ibadan Botany Studies 5: 18p.

Includes data on the status of the soil under teak and *Cassia stamea* and content of the leaves, stems and litter of teak in ash, N, Ca, and K. The two species are not considered suitable in mixture since their demands on the soil are similar.

2429 OL, J.F. 1909. **Experiences with *Leucaena glauca* - interplanted crop in teak**. (Dutch). Tectona 1: p469.

2430 Osemeobo, G.J. 1989. **An impact and performance evaluation of smallholder participation in tree planting, Nigeria**. Agricultural Systems 29(2): 117-135.

Smallholder participation in afforestation is thought to promote environmental stability, underplanting of food crops, longer fallow periods and short rotations, benefits to the farmer such as domestic supply of wood and additional income and improved wood supply.

2431 Osmaston, L.S. 1907. **The system of agriculture combined with forestry in the Deccan of the Bombay Presidency**. Indian Forester 33(6): 265-273.

Report on experimental line sowings of teak and other tree species along with field crops in the dry parts of Bombay Deccan.

2432 Pandeya, S.C. 1960. **Comparative distribution characteristics of sal and teak in Madhya Pradesh**. Proceedings of the 9th Silvicultural Conference, Dehra Dun, 1956, Part 2: 112-117.

2433 Prahasto, H. 1987. **The influence of taungya systems in teak forest on the social economics of the local community**. Jurnal Penelitian dan Pengembangan Kehutanan 3(2): 8-11.

Analysis of data from Indonesia showed the labour force required in traditional and mass intensification taungya systems, average income and household income of the farmers.

2434 Prasad, R. 1991. **Underplanting of *Stylosanthes* legume crop in teak seed orchards**. Vaniki Sandesh 15(1): 1-5.

Underplanting of *Stylosanthes hamata* in clonal seed orchards of teak at Nepanagar, Madhya Pradesh reduced growth of wild grasses, increased soil fertility and provided good yields of fodder.

2435 Puri, S. 2003. **Are intensive teak plantations in agroforestry practices environmentally and ethicallly sound?** International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

The paper examines the possibilities of growing teak under various agroforestry system, viz., taungya, spatial agroforestry system, silvopastoral system and home gardens. Possibilities of growing some suitable crops and grasses have been examined. How the biophysical factors like light, water, nutrients and root behaviour play a role in increasing tree productivity has been discussed.

2436 Purwanto, R.H; Ito, K; Oohata, S. 2003. **Yields of cash crops in a planted teak forest under agroforestry management in Madiun, East Java, Indonesia**. Forest Research, Kyoto 75: 19-25.

Determined the yields of cassava, maize, rice, groundnut and soyabean which were grown in a planted teak forest in East Java, Indonesia.

2437 Rachadi. 1981. **The intensification of intercropping in forests**. (Indonesian). Duta Rimba 7(50): 18-23.

The silvicultural and socioeconomic advantages of intercropping with food crops in teak forests in Indonesia are described and intensification of its use is advocated.

2438 Rajendran, K; Gunasekaran, T; Devaraj, P. 2003. **Performance of teak (*Tectona grandis* Linn.f.) and rice (*Oryza sativa*) in the agrisilvicultural system in Southern Tamil Nadu**. Range Management and Agroforestry 24(1): 74-76.

Teak trees were planted on the bunds of rice fields and biomass were recorded after ten years of growth. Results indicate that teak can be successfully intercropped with rice under irrigated and rainfed conditions.

2439 Ranasinghe, D.M.S.H.K. 1991. **Agroforestry and community forestry in Sri Lanka**. Sri Lanka Forester 20(1/2): 45-49.

A brief account is given of current agroforestry practices. Systems described include shifting cultivation, taungya in teak plantations, cash cropping systems, intercropping under coconuts and rubber, alley cropping, conservation farming, farm forestry and silvopastoral systems.

2440 Ranasinghe, D.M.S.H.K; Newman, S.M. 1993. **Agroforestry research and practice in Sri Lanka**. Agroforestry Systems 22(2): 119-130.

A review of agroforestry research and practice in Sri Lanka is given with emphasis on traditional systems, plantation intercropping, silvopastoral systems, fertility improvement and community forestry.

2441 Roder, W; Keoboualapha, B; Manivanh, V. 1995. **Teak (*Tectona grandis*), fruit trees and other perennials used by hill farmers of northern Laos**. Agroforestry Systems 29(1): 47-60.

Surveys and investigations in Luang Prabang Province, Laos shows that farmers preferred teak over fruit trees and coffee because of the better market potential, cash income and wood demand for construction and securing of land tenure. Insufficient financial resources, non-availability of land, lack of seedlings, lack of labour and lack of experience were regarded as the main reasons for not planting teak.

2442 Roosendael, J van. 1927. **Artificial mixing of teak with other trees**. Tectona 20(12): 1003-1020 (Indian Forester 55, 1927: 242-243).

The author describes the different mixtures adopted for different soils. An essay on method of cultivation and mixtures to be adopted on good, mediocre and bad soils is also included.

2443 Roosendael, J van. 1928. **Underplanting trials with Tectona at Krandegen**. (Dutch; English). Tectona 21: 316-333.

Results are presented of different under planting trials undertaken by the author.

2444 Roosendael, J van. 1929. **Mixed cultures of teak and other trees**. Indian Forester 54(4): 242-243.

The paper lists the advantages of mixing teak with other species and recommends optimum mixtures for good medium and poor quality sites.

2445 Roosendael, J van. 1929. **Systematic artificial mixing of teak and other timber species in Java**. Tectona 22: 1015-1033.

2446 Salomon, T. 1911. ***Leucaena glauca* and wedoesan.** Tectona 4: 732-733.

2447 Saravanan, S; George, M; Buvaneswaran, C. 2003. **Cultivation of teak (*Tectona grandis*) in farmland under different agro climatic zones of Tamil Nadu - an analysis of ecological and economic factors**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Ecological factors which favour or limits the growth, yield and timber quality were analysed and results presented. The socio-economic factors for shifting to teak cultivation, from conventional agricultural practices, were analysed and ranked according to Garrett Ranking Technique. The socio-economic profile of teak growing farmers in Tamil Nadu is also depicted. This study confirms that with proper site selection and management practices, teak is one of the best suitable tree species for agroforestry system under short rotation.

2448 Scherr, S.J; Current, D. 1997. **What makes agroforestry profitable for farmers? Evidence from Central America and the Caribbean**. Agroforestry Today 9(4): 10-15.

2449 Sen, N.N. 1965. **Trend of development of forestry in Haldwani, Ramnagar and T and B divisions of Uttar Pradesh during the last 50 years**. Indian Forester 91(3): 158-169.

Describes the techniques of enriching degraded forest by underplanting with teak and other valuable species, the large-scale mechanized planting of quick-growing species.

2450 Shankar, U; Lama, S.D; Bawa, K.S. 1997. **Ecosystem reconstruction through taungya plantations following commercial logging of a dry, mixed deciduous forest in Darjeeling Himalaya**. Forest Ecology and Management 102(2/3): 131-142.

This study examines ecosystem recovery after the conversion of a dry, mixed deciduous forest into a taungya plantation. Planted tree species include *Tectona grandis* with various associate species like agricultural crops.

2451 Shinde, S.R; Ghatge, R.D; Mehetre, S.S. 1999. **Growth and development of sandal wood and its host (*Casuarina*) with teak in mixed plantation**. Indian Journal of Forestry 22(3): 253-256.

An experimental mixed planting of teak and *Casuarina equisetifolia* as host to the semi-root parasite *Santalum album* was tried at the Agricultural College Farm at Kolhapur in Maharashtra in order to study the suitability of this mixture on marginal soils. It is suggested that the marginal soils of this region can be utilized successfully for mixed plantations of these trees.

2452 Singh, G; Tripathi, S.P. 1998. **Effect of *Eucalyptus tereticornis* shelterbelt on young teak plantation: A case study**. Indian Forester 124(3): 206-210.

Observations made on a teak plantation at Bhavnagar, Gujarat planted along the *Eucalyptus tereticornis* shelterbelt shows that the *E. tereticornis* affected the growth of teak up to a distance of 180 m. and the maximum reduction was observed in the first row of plants. The results suggest that nutrient availability in general and light in particular accounted for the poor growth of teak beneath the shelterbelt canopy.

2453 Siswantoyo. 1981. **Labour opportunities in taungya and other forms of agroforestry**. Observations of agroforestry on Java, Indonesia. Report on an agroforestry course, Gadjah Mada University, Yogyakarta: 62-67. K.F. Wiersum, Ed. Department of Forest Management, Agricultural University, Wageningen, Netherlands.

Reforestation with teak and pine using taungya systems, for soil conservation using small trees as terrace stabilizers, and schemes for erosion control and catchment management on slopes is discussed.

2454 Slinkers, T.L. 1937. **The influence of cutting the interplanting of *Leucaena glauca* in teak plantations**. (Dutch; English). Tectona 30(11): 860-873.

The study of cutting the interplanted *Leucaena glauca* auggested that time and frequency of cutting has no influence on the growth of teak, April cutting is better and cut to limit weed growth, soil drying and wind damage.

2455 Smith, R. 1977. **Gap planting of *Tectona grandis* in logged mixed dipterocarp forest: Interim report**. Forest Department, Sarawak, Forest Research Report 17: 16p.

Teak seedlings were planted in logging gaps in the Niah Forest Reserve. Six months after planting, average mortality and height increment were noted.

2456 Soekartiko, B. 1980. **Experiences with intensified taungya on forest lands**. (Indonesian). Indonesia, Gadjah Mada University, Forestry Faculty:- Experiences with agroforestry on Java, Indonesia:-Pengalaman dengan agroforestry di Jawa, Indonesia: 141-158. Fakultas Kehutanan, Universitas Gadjah Mada, Yogyakarta, Indonesia.

A detailed account of the system of intensified taungya successfully applied in the Banyumas-Barat forest district of Java is given.

2457 Soekeri. 1980. **Mix cropping between teak and lac tree (*Schleichera oleosa*)**. (Indonesian). Gema Rimba 6(41/42): 39-45.

2458 Soemarwanto, O. 1982. **Cultivation pattern research at 1980/1981 teak intercropping plantations**. (Indonesian). Duta Rimba 8(56): 11-13.

Taungya trials with rice, maize, soyabean and small green peas, Gajah and peanuts and other food crops are reported.

2459 Sujatha, M.P; Jose, A.I; Sankar, S. 2001. **Reed underplanting in older teak plantations: A healthy soil management practice**. Tropical Forestry Research: Challenges in the New Millennium. Proceedings of the International Symposium, Peechi, India, 2-4 August 2000. R.V. Varma; K.V. Bhat; E.M. Muralidharan; J.K. Sharma, Eds: 168-170. Kerala Forest Research Institute, Peechi.

Indicate that the health of soil with respect to erosion status, structure, alluvial clay, bulk density, water holding capacity and organic carbon was significantly better in teak with reed as undergrowth than without it.

2460 Sunderlin, W; Sullivan, G.M; Huke, S.M; Fox, J.M (Eds). 1992. **Benefits, costs, and equity: Analysis of a social forestry site in Central Java**. Financial and economic analyses of agroforestry systems: Proceedings of a Workshop, Honolulu, Hawaii, USA, July 1991: 261-270. Nitrogen Fixing Tree Association, Paia, USA.

Java Social Forestry Programme managed by the State Forestry Corporation of Indonesia assigned the degraded forest land to participating households for use as forest farm land, on which both crops and teak forests are raised. Results of the analysis of data from such a social forestry site is presented.

2461 Sutherland, S. 1993. **Performance of *Tectona grandis* in live fences in Panama**. Enlace Madelena 3(2): 1; 4-5. Centro Agronomico

Tropical de Investigacion y Ensenanza, Turrialba, Costa Rica.

2462 Sweet, J.M. 1923. ***Artocarpus hirsuta* as an underwood for teak**. Indian Forester 49(5): 248-251p.

Attempts on underplanting and recommends its introduction in teak plantations just before 2nd or 3rd thinning to suppress epicormic branches are described.

2463 Tee, B; Paterl, F; Chiew, A. 1995. **Teak in Sabah - a sustainable agroforestry**. Sejati Sdn Bhd, Sabha, Malaysia: 77p.

2464 Teyadhiti, M; Vimuktalob, C. 1992. **Feasibility study on agrosilvicultural system involving teak by the farmer**. Proceedings of the Seminar on 50 Anniversary of Huay-Tak Teak Plantation, Thailand, 5-8 August 1992.

Study finds that an intensive cultivation of teak together with field crops will yield high economic return and generate farm income of the farmers during the time teak trees are approaching the felling stage.

2465 Tobi, E. 1909. **Interplanting of *Leucaena glauca***. Tectona 1: p603.

2466 Venkataramany, P. 1956. **Underplanting in teak plantations in Madras State**. Indian Forester 82(5): 225-236.

Reviews the results of some small scale experiments in underplanting teak plantations and concludes that underplanting of pure even-aged teak with bamboo or tree species will reduce volume increment of teak.

2467 Venkatesh, C.S. 1974. **Teak versus semal- A dialogue in the forest**. Indian Forester 104(7): p479.

Characters of the two species from the point of utility, biological characters and breeding feasibility are discussed.

2468 Verinumbe, I; Okali, D.U.U. 1985. **The effect of coppiced teak regrowth on soil in a teak-maize agroforest**. Forest Ecology and Management 12(1): 37-41.

The effects on soil and roots of coppiced teak regrowth in a maize-teak mixture in Nigeria were investigated and suggested that soil nutrient changes due to canopy or surface roots of coppiced teak regrowth are too small to influence the performance of intercropped maize in the first season following coppicing.

2469 Verinumbe, I; Okali, D.U.U. 1985. **The influence of coppiced teak (*Tectona grandis* Linn.f.) regrowth and roots on intercropped maize (*Zea mays* L.)**. Agroforestry Systems 3(4): 381-386.

Results showed that competition for light was more important than root competition in reducing the yield from the maize.

2470 Voogd, C.N.A de. 1928. **Artificial mixing of teak and other timber species**. (Dutch; German). Tectona 21: 527-533; Forest Rundschan, Indonesia 1: p348.

2471 Walker, H.C. 1912. **Teak and bamboo in Burma**. Indian Forester 38(12): 583-599.

Experimental data on growth of teak with special reference to bamboo flowering is presented.

2472 Watanabe, H; Sahunalu, P; Khemnark, C. 1988 . **Combinations of trees and crops in the taungya method as applied in Thailand**. Agroforestry Systems 6(2): 169-177.

The paper describes the crop combinations used to rehabilitate waste land in Thailand. The major combinations included teak with upland rice, maize or sorghum.

2473 Watson, G.A. 1980. **Tree intercropping possibilities**. Proceedings of the Agricultural Sector Symposium, 7-11 January 1980: 139-159. World Bank, Washington DC, USA.

Include the description of the taungya system with teak planting. Possible developments in the taungya system are briefly discussed.

2474 Wepf, W. 1955. **Mixing in teak plantations**. (Dutch; English). Tectona 43: 290-294.

2475 Wesley, D.G. 1964. **Accelerated forestry**. Myforest 1(3): 28-26.

Trials of eucalypt - teak mixtures in Mysore state proved satisfactory.

2476 Willemsen, J.W. 1911. ***Leucaena glauca***. Tectona 3: p170.

2477 Win, S; Kumazaki, M. 1998 . **The history of taungya plantation forestry and its rise and fall in the Tharrawaddy Forest Division of Myanmar (1869-1994)**. Journal of Forest Planning 4(1): 17-26.

The taungya system is believed to have originated in the Tharrawaddy Forest Division of Myanmar and was devised by Dr. Dietrich Brandis after observing the taungya practices of the Karen hill people. Taungya teak plantations expanded in the Tharrawaddy Forest Division from 1869, as teak grows well in this area and the facilities for teak timber extraction are good.

2478 Wongsakulwiwatana, S; Manmuang, S; Anekkana, S. 1979. **Growth study of teak in enrichment plantation with and without interplanting field group**. (Thai). Report on Silviculture 1977-1978. Royal Forest Department, Ministry of Agriculture and Cooperatives, Bangkok.

2479 Yadav, R.S; Ram, M; Solanki, K.R; Kareemulla, K; Singh, R. 2003. **Economic evaluation of agri silviculture under irrigated condition in Bundelkhand Region of India**. Indian Journal of Soil Conservation 31(2): 210-213.

Black gram and wheat were grown intercropped between teak, neem and *Albizia procera* and evaluated the yield of the crops.

2480 Yingransiri, T; Sumantakul, V. 1979. **Mixed cultivation of teak (*Tectona grandis* Linn.f.) with *Pinus* spp**. (Thai). Report on Silviculture 1977-78: 76-77. Royal Forest Department, Ministry of Agriculture and Cooperatives, Bangkok.

2481 Zachariah, P.K. 1997. **Teak and taungya with particular reference to biotic and environmental factors**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 253-258. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

The taungya system was introduced first in 1915, in a teak plantation in Konni Forest Division. In 1986, the government banned the taungya in forest plantations as various ill effects of taungya in teak plantations have been projected by researchers. Reintroduction of taungya plantations in smaller extent with proper modification of the system is proposed.

2482 Zeng, B.S; Yin, G.T; Xu, H.C; Liu, Y; Feng, C.L; Lu, S.A. 2003. **Afforestation of *Calamus simplicifolius* by tube-seedlings**. (Chinese). Forest Research, Beijing 16(2): 240-244.

The survival rate of tube-seedlings planted in different areas including teak forests is reported as more than 90 percent.

Go top

Harvesting

(See also 0375, 0530)

2483 **Extract from Madras Athenoeum**. Indian Forester 10, 1884: 318-319.

The price of teak wood from Burma was compared and the price was almost doubled due to great demand in far-eastern markets especially Australia.

2484 **Improvement fellings for the benefit of teak in Burma**. Indian Forester 25(8), 1899: 320-323.

With reference of Mr. Nisbet's note on improvement fellings in fire protected areas, with reference to prevailing teak forests of Burma, current methods of teak regeneration, artificially and by taungyas are critically examined and reviewed.

2485 **Extraction of teak timber in the Pyinmana forest division, upper Burma**. Indian Forester 38(4), 1912: 151-154.

2486 **Optimization of the level of mechanization of logging in teak (*Tectona grandis*) forest on Java using the isoquant method of Sundberg**. Duta Rimba 129/130, 1991: 16-20.

2487 Adu Anning, C; Blay, D Jr. 2001. **Ensuring sustainable harvesting of wood: Impact of biomass harvesting on the nutrient stores of teak woodlot stand in the Sudan Savanna**. Ghana Journal of Forestry 10: 17-25.

2488 Arifin, Z; Surjokusumo, S. 1974. **The transport of teak (*Tectona grandis*) by railway in Java**. Laporan, Lembaga Penelitian Hasil Hutan 36: 23p.

Reports an investigation of the methods of construction, maintenance and operation of light railways which have a variety of gauges and rail sizes. Time studies of log transport with manual or locomotive traction are included.

2489 Bake, H.W.A van den Wall. 1908. **The exploitation of teak forests of Java**. (Indonesian). Indische Mercur 31(8): p129.

2490 Banijbhatana, D. 1953. **The departmental working of forests in Thailand**. The Royal Forestry Department Bulletin 4.

As the exploitation proved to be of great benefit to the welfare of forests as well as to the national economy, more teak forests were taken up for departmental working. The forest industry organization was established and managing three big saw mills of Bangkok and a plywood mill is also planned for installation .

2491 Basari, Z; Ishak, S. 1997. **Harvesting system in teak forest in Java**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 73-75. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

In Java, conventional logging system is still practiced in teak forests due to various socio-economic reasons. To improve the social condition of the forest labourers, Perum Perhutani has built up resettlement called Magersaren near the forest. Various aspects of felling operations including non-technical preparation, operational felling and utilization of Tirfor are discussed.

2492 Becking, W; Becking, J.H. 1919. **The exploitation of teak thinnings**. Tectona 12: 1-63.

2493 Bellers, H. 1925. **Chronological survey of the keeping of the exploitation in the teak forests of the department in the residency of Djokdjakarta**. (Indonesian; English). Tectona 15: 355-400.

2494 Brascamp, E.H.B. 1921. **Teak exploitation in Pangesana in 1728 & 1729, in Kolonial Archief No. XXVII**. Tectona 14(2): 998-1020.

2495 Butterwick, A.J. 1919. **Girdling of teak trees in Burma**. Indian Forester 45(12): 65-67.

Discusses the width of the cut to be given for effective girdling.

2496 Cermac, F. 1957. **The pure teak stands of Java and their utilization**. (German). Schweizerische Zeitschrift Fur. Forstwesen 108(3): 175-188.

A general account of the natural and planted teak forests, their management, establishment and yield, logging, transport and primary conversion and utilization including mill equipment is given from the author's own experience.

2497 Classen, J.C van R. 1915. **Cutting cycle**. (Indonesian; English). Tectona 8: 109-114.

A general article on rotation of teak.

2498 Coster, C. 1930. **Observations on girdling of teak (*T. grandis* L.f.)**. (Dutch; English). Tectona 23: 166-182.

The present study indicates that shrinkage, swelling, or physical properties of wood are not effected by length of period of girdling.

2499 Coster, C. 1930. **On the influence of girdling on the properties of teakwood more specifically on its cleaving**. (Dutch; English). Meded Proefsta Boschw 18: 98-199.

An investigation made to test the traditional impression that by girdling teak two years in advance of felling, cracking of wood is prevented and conversion of larger sized teak is greatly facilitated.

2500 Coster, C. 1931. **Influence of girdling on Java teak**. Empire Forestry Journal 10: p148.

2501 Decamps, A. 1955. **Teak logging in Siam**. (French). Bois et Forests des Tropiques 42: 26-36 .

Describes the use of girdling, felling methods, the employment of elephants for skidding logs to the launching place, and the process of floating and rafting to the mills. The advantages of employing elephants rather than tractors are emphasized.

2502 Deventer, A.J van. 1910. **About clearing of natural teak forests in Nogmaals-1909**. (Dutch; English). Tectona 2(1): 22-30.

2503 Deventer, A.J van. 1914. **Further observations on the cutting cycle and the regulation of operations in the teak forests in Java**. (Dutch; English). Tectona 7: 721-747.

2504 Dijkmans, M.A.F. 1931. **Clear cutting in Tectona plantations**. Tectona 24: 141-202.

2505 Dijkmans, M.A.F. 1931. **Discussions on clearcutting in *Tectona***. Tectona 24: 424-450.

2506 Doorn, A van. 1924. **The need for rails and rail-roads in teak forests in Java**. Tectona 17: 676-685.

2507 Doorn, Z van. 1931. **Mechinale verzaging De Nieuwe phase in de ontwikkeling van de edploitatic in Eighen Beheer Deer Djatiboschen op. Java**. Tectona 24: 1-38.

Mechanical treatment in the new phase of development in the exploitation of the departmental business of teak in Java.

2508 Dulsalam. 1990. **The effects of slope and load volumes on the productivity of a hand cart in teak forests**. (Indonesian). Jurnal Penelitian Hasil Hutan 7(1): 8-11.

Data are reported from a work study in teak forest in East Java, in which the effects of four slopes and four load volumes were tested on the productivity of log hauling using a hand cart.

2509 Ellis, E.V. 1912. **Department teak extraction in the Zigon division, Burma**. Indian Forester 38(1): 18-27.

2510 Endom, W. 1997. **Log split in teak felling operation**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 76-80. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

This preliminary study was carried out to develop a practical, simple and cheap equipment to reduce log split during felling operation.

2511 Gajaseni, J; Jordan, C.F. 1990. **Decline of teak yield in northern Thailand: Effects of selective logging on forest structure**. Biotropica 22(2): 114-118.

The decrease in yield has been attributed to loss of trees for shifting cultivation and intensive agriculture. Because of over exploitation of large trees, profitable yield will not be possible.

2512 Garcia, C.J.R. 1973. **Application of intermediate fellings in plots of *Tectona grandis* in Araure-Acarigua, Venezuela**. (Spanish). Revista Forestal Venezolana 16(23): 67-82.

Effects of thinning have been studied. The nine experimental plots differed in spacing and in frequency of thinning. Data on the mean annual increments in height, basal area and volume are tabulated.

2513 Hai, Hato. 1917. **Commercial vs. quasi commercial departmental teak extraction in Burma**. Indian Forester 43(3): 111-116.

The author examines the problems of commercial working and suggests recruiting special timber working staff on a commercial basis without administrative duties and technical training.

2514 Hole, R.S. 1916. **Teak reproduction as a result of clear felling**. Indian Forester 42(2): 51-57.

Describes an experiment on the effect of shade and admixture of dead teak leaves in the soil on the germination of teak. Results indicated germination is better and admixture of dead leaves material improved both percentage of germination and also vigour of young plants.

2515 Idris, M.M; Basari, Z; Soenarno. 1986. **Effectiveness of using tirfor and lever block on teak felling in Central Java**. (Indonesian). Jurnal Penelitian Hasil Hutan 2(4): 8-13.

2516 Idris, M.M; Soenarno. 1990. **Mechanization of teak felling in order to reduce dependence on a limited forest labour supply in Java**. (Indonesian). Jurnal Penelitian Hasil Hutan 6(8): 471-476.

A study was conducted in Central Java in which the productivity of three felling systems of mechanized, manual, and the combination of the two was compared on teak. Productivity was better in the case of mechanised felling.

2517 Idris, M.M; Suhartana, S. 1987. **The effect of calorie intake on the performance of teak loggers in Jombang Forest District**. Jurnal Penelitian Hasil Hutan 4(3): 17-20.

Average productive working hours of teak fellers in Jombang District, Indonesia, were analysed for different age groups and eating frequencies.

2518 Idris, M.M; Tjarmat, E; Sastrodimedjo, R.S. 1982. **Effectiveness of Tirfor to reduce wood damage in teak felling**. (Indonesian). Laporan, Balai Penelitian Hasil Hutan, Indonesia 160: 17-22.

A description is given of trials with the Tirfor winch designed to control the direction of tree fall. Regression equations are given that related diameter and slope to damage.

2519 Jouvanceau, J; Lepitre, C. **Mechanized extraction of teak poles in Dahomey**. (French). Bois et Forests des Tropiques 87: 35-48.

Bundles of logs are skidded by means of a 35-h.p. agricultural tractor equipped with a winch in front and an A-frame at the rear as with an arch. Costs and efficiency of this method are compared in detail with those of hand skidding.

2520 Kammesheidt, L; Franco, W; Plonczak, M. 2001. **History of logging and silvicultural treatments in the western Venezuelan plain forests and the prospect for sustainable forest management**. Forest Ecology and Management 148(1/3): 1-20.

2521 Keddy, C.V.K. 1967. **Saving in wood by felling with saw**. Indian Forester 93(4): 258-263.

A study was made to ascertain the amount of wood wasted by axe felling for trees of several girth classes and consequent financial loss. An advantage of felling by saw is that it is not necessary to trim the stumps to encourage coppicing as is done after axe felling.

2522 Kools, J.F. 1976. **Historical view of the utilization of the railway in the teak forest area**. (Indonesian). Kehutanan, Indonesia (Forestry in Indonesia) 3(10): 263-268.

2523 Lindgren, P. 1986. **A handbook on basic logging and transport methods adapted to typical conditions in India**. 128p. Forskningsstiftelsen Skogsarbeten, Spanga, Sweden.

Logging and transport systems using gravity, men, draught animals, farm tractors and trucks are covered. Seven case studies of Orissa, Maharashtra and Jammu-Kashmir are made. The case studies include selective thinning in plantations of teak also. Based upon these studies, suitable methods, tools and equipment are recommended.

2524 Maman, M.I; Zakaria, B. 1985. **Effectiveness of using tirfor and lever block of teak felling in Central Java**. Forest Products Research and Development Centre, Bogor, Jakarta.

2525 Mangundikoro, A. 1974. **A costing system for teak forest logging in Java**. Laporan, Lembaga Penelitian Hasil Hutan 34: 26p.

Describes an improved cost accounting system for the Indonesian state forest enterprise Perhutani in the *Tectona grandis* forests. The system enables the unit product cost of the separate products of logs, squares, and fuelwood.

2526 Masuko, H. 1987. **Illicit felling in Thailand**. (Japanese). Tropical Forestry 9: 32-39.

Estimates of illicit felling of teak in Thailand. Examples of illicit felling and its effects and the comments of local newspapers are described.

2527 Miedler, K.A. 1957. **Report to the Government of Burma on mechanization of teak extraction**. Expanded Technical Assistance Program, FAO, Rome. FAO Report 614: 53p.

Describes an experimental extraction unit.

2528 Mitra, S.K; Sood, K.G. 1980. **Timber transportation - a comparative study**. Indian Forester 106(8): 533-544.

A study was made of the timing and the cost of transporting teak logs.

2529 Narayanamurti, D; Prasad, B.N; Singh, K. 1963. **Temperature changes in woodworking tools**. Norsk Skogind 17(9): 357-358.

Some results of trials, in which thermocouple was used to measure the temperature during wood turning.

2530 Nisbet, J. 1899. **Note on improvement fellings for the benefit of teak in fire protected reserved forests**. Indian Forester 25(5): 202-214.

A note on improvement fellings in the fire-protected reserved teak forests. Notes of Inspection and observations are described in detail.

2531 Pahlitzsca, G; Schulz, K. 1957. **Planning with rotary cutters: Measuring the cutting force and edge-wear**. Holz als Roh-und Werkstoff 15(4): 159-170.

A new method and experimental apparatus are described and results of experiments are presented.

2532 Predjorahardjo. 1990. **Analysis of teak forest age classes in Perum Perhutani Unit II East Java**. (English; Indonesian). Duta Rimba 16(121/122): 3-13.

Age class analyses are given for the teak forests of East Java. The area of each class tends to decrease with time because of clear felling in mature stands and damage in young stands. The effects of felling cycle and felling age for sustained yield are discussed.

2533 Rand, C. 1959. **Work animals of the orient**. Natural History 68(7): 384-399.

Deals with use of elephants for teak logging in India.

2534 Rao, D.S; Singh, B.P. 1991. **Wastage of timber at tree harvesting stage in South India**. Indian Forester 117(8): 609-617.

Observations were made at sites in Andhra Pradesh, Karnataka, Tamil Nadu and Kerala on the extent of wastage during various logging operations. It is suggested that reduction of wastage can be achieved by use of the proper tools, proper tool maintenance and proper training.

2535 Rodger, A. 1915. **Teak floating in the lower Burma in the dry weather**. Indian Forester 41(9): p2.

The problems of teak floating are discussed and suggestions are made for clearing the river beds.

2536 Sagreiya, K.P. 1939. **The efficiency of irregular stocking paper VIII. The efficiency of irregular stocking with special reference to the Central Provinces forests**. Proceedings of the 5th Silvicultural Conference, Dehra Dun, 1939, 8: 192-195. Forest Research Institute, Dehra Dun.

2537 Singhal, R.M. 1949. **Timber floating in Godavari, Indravati and Pranhita Rivers**. Indian Forester 75(8): 300-301.

2538 Sivarajan, M. 1963. **The first harvest of mature teak plantation in Thenmala Forest Division**. Keralaranyan: 66-68.

Gives the history of teak plantation in Thenmala Forest Division of Kerala state.

2539 Soenarno; Mansyur, M. 1990. **The effect of improved felling system in various field topographies on the quality of teak wood products**. (Indonesian). Duta Rimba 16(121/122): 14-19.

Data are presented on the percentage of quality teak obtained from mechanized and manual felling and from a combination of both types of felling, in flat and hilly terrain in Central Java.

2540 Soenarso, S. 1978. **Guidance operational handsaw technique on teak forest**. Forest Research and Development, Bogor.

2541 Soenarso, S; Ishak, S. 1979. **The improvement of felling technique in Java**. Ergonomics in tropical agriculture and forestry: 132-133. PUDOC, Wageningen, Netherlands.

In teak logging operations, need of improvement in felling and saw maintenance is suggested.

2542 Soernnggabjiwa, M.H. 1964. **Evaluation of the current method of allowable cut determination in teak forests**. (Indonesian). Rimba Indonesia 9(1): 41-54.

The method of calculating the allowable cut in teak forests of Indonesia based on actual wood volume of over mature stands plus that of immature stands at rotational age and rotation is described and discussed other methods and compared with Von-Montal's method.

2543 Soeters, K. 1917. **Clear cutting in secondary teak crops**. Tectona 10: 927-943.

2544 Soewito; Sastrodimedjo, R.S; Wirapradja, A. 1975. **Situation of forest worker supply in Java**. (Indonesian). Laporan, Lembaga Penelitian Hasil Hutan 51: 16p.

Reports a sample survey of workers interviewed at 42 forest-exploitation sites in Indonesia.

2545 Srisook, P. 1962. **A merchantable logging of teak in Lampang**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Data of the expenditure for extraction is given.

2546 Suhartana, S; Idris, M.M. 1990. **Anthropometric data from teak loggers in Bandungsari sub-forest district - Purwodadi forest district, central Java**. (Indonesian). Jurnal Penelitian Hasil Hutan 71: 28-33.

Anthropometric measurements were reported for teak loggers, as part of an ergonomic study.

2547 Sukwathana, P. 1963. **Capital cost of extraction of teak by the forest industry organization in Prac Province**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Costs of teak extraction is given.

2548 Sumantri, I. 1983. **Use of Tirfor for felling activity in teak**. (Indonesian). Laporan, Pusat Penelitian dan Pengembangan Hasil Hutan, Indonesia 169: 17-27.

Investigated the wood damage by the use of the Tirfor winch and compared with the use of a handsaw. The Tirfor needed more man-hours than the handsaw.

2549 Tattiemromya, P. 1958. **Teak stealing**. (Thai). Vanasarn 16(2): 11-17.

Four methods of irregular cutting and smuggling of teak in Thailand are described and measures to arrest it are discussed.

2550 Thephasdin, M. 1970. **Teak in the forest insistently deteriorated by means of getting**

away with forest law. (Thai). Vanasarn 28(3): 290-295.

The present forest law is considered not very strict. The author also discusses the socio-economic problem of people in the Northern region of Thailand who are depending on illegal cutting of forests.

2551 Troup, R.S. 1910. **Memorandum regarding prescriptions for improvement fellings in teak working plans in Burma and the introduction of a more uniform system of working**. Indian Forester 35(10): 583-595.

Discusses the present prescriptions in the working plans of teak forests of Burma and suggests a more uniform system of working and various operations to be carried out for obtaining uniform stocking. The details of girdling, extraction and improvement felling are described and also proposals for cleaning and thinnings in the plantations are given.

2552 Wanakich, L.P. 1952. **A short note on teak timbers stealing in the forests of Northern Thailand**. (Indonesian). Vanasarn 10(2): 41-45.

The measures adopted by the forestry service to arrest illegal cutting of timber in the northern part of Thailand are described.

2553 Wartono Kadri; Soewito; Hasan Muharam, E. 1970. **Experience in research on skidding with draught cattle at Tjepu forest district**. (Indonesian). Laporan, Lembaga Penelitian Kehutanan 113: 27p.

Describes a traditional technique for extracting teak logs, including the use of pulleys to increase traction and reports results of a work study on the use of 1-5 pairs of animals yoked together, in order to increase efficiency without losing traditional skills.

2554 Westra, J.G. 1922. **Results with the K. Stump puller in the teak forest district Gedangan (Java) in 1921-22**. (Dutch; English). Tectona 15: 1111-1116.

Advantage of pulling the trees with the K-stump-puller is dealt with.

2555 Wroughton, F.H. 1940. **Burma teak and its extraction**. Journal of South African Forestry Association 5: 5-9.

An account of the wood, the country in which the tree is found, and the method of its extraction, with particular reference to the use of elephants in this work are dealt with.

2556 Zwart, W. 1938. **Cost of cutting and extraction of departmentally worked teak at Tjepoe**. (Dutch). Tectona 31(3): 149-161.

Data is given of the cost of extraction of teak.

Go top

Injuries and Protection

2557 **Control method for stem division in teak forests**. (Indonesian). Majalah Kehutanan Indonesia 12, 1983: 24-26.

2558 Browne, F.G. 1968. **Pest and diseases of forest plantation trees**. 1330p. Clarendon Press, Oxford.

2559 Chalermpongse, A; Boonthavikoon, T; Chairuangsirikul, T. 1990. **Surveillance of disease and insect damage of teak plantations in Thailand**. Proceedings of IUFRO Workshop on Pests and Diseases of Forest Plantations, Bangkok, 5-11 June 1988: 224-235. C. Hutacharern; K.G. MacDicken; M.H. Ivory; K.S.S. Nair, Eds.

2560 Deventer, A.J van. 1911. **Protection of Tectona forests against wind**. (Dutch; English). Tectona 4: 561-572.

2561 Forest Research Institute, Dehra Dun. 1928. **Mortality of teak trees in thinned and unthinned plantations**. Forest Research in India, Forest Research Institute, Dehra Dun: p23.

2562 Forest Research Institute, Dehra Dun. 1953. **Mortality of sal and teak in Gorakhpur Division**. Forest Research in India Part I (1952-53): p75.

The mortality of teak trees observed in Pharenda range is tentatively attributed to drought and severe damage to the bark by the termite *Odontotermes parvidens* Holmg and Holmg.

2563 Forest Research Institute, Dehra Dun. 1954. **Mortality of teak in Mandvi range**. Forest Research in India Part II 1953-54: 23-24.

Heavy mortality of teak observed is attributed to prolonged drought and the continuous working of the forests.

2564 Forest Research Institute, Dehra Dun. 1961. **Mortality in forest species (sal, casuarina, teak, spruce etc)**. Proceedings of the 10th

Silvicultural Conference, Dehra Dun: 774-784.

The causes of mortality of teak and other species are discussed.

2565 Hadipoernomo. 1978. **The problem of wood thefts in the teak forests**. (English; Indonesian). Duta Rimba 4(27): 20-25.

2566 Hadipoernomo. 1981. ***Acacia arabica* as a hedge crop**. (Indonesian). Duta Rimba 7(46): 13-15.

The use of the multipurpose species *A. arabica* as a thorny hedge round teak forests in Indonesia is described for the prevention of cattle penetration.

2567 Jamaluddin. 2003. **Tree health of teak in central part of India**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Teak is prone to be damaged by a number of fungal pathogens affecting seed, root diseases, stem and branch canker and die back, collar rot, heart rot in dry coppice teak and mortality in natural teak forests. Bacterial diseases in nursery and plantations also caused considerable losses. Some of the established control/managements tactics were also described.

2568 Jha, M. 1995. **Mortality in pure teak plantation**. Indian Forester 121(6): 576-577.

Mortality of teak plantation in Maharashtra is reported. Mortality is attributed to drought and damage by termites.

2569 Kalshoven, L.G.E. 1928. **Teak forests in Java as affected by injuries, diseases and pests**. (Dutch; English). Tectona 21: 593-623.

A review on various diseases, insect pests, damages and injuries caused to teak forests.

2570 Kotwal, E.K. 1959. **Teak in Bombay-some problems**. Proceedings of All-India Teak Study Tour and Symposium, December 1957 to January 1958: 157-158.

Discusses the damage to teak forests and plantations of Bombay due to injuries and *Loranthus* attack. Black cotton soils cause heavy mortality after middle age due to water logging, in addition to developing fluting and forking defects.

2571 McDonald, T. 1940. **Bori Reserve, 1859-1940** . Indian Forester 66: 529-543.

A historical review of the teak forests of Bori Reserve, in the Central Provinces of India. These forests were the first in India to be reserved and fire protection was practised probably earlier than in any other-part of the tropics.

2572 Pinzon Florian, O.P; Moreno Beltran, H. 1999. **Phytosanitary problems of *Tectona grandis* and *Gmelina arborea*: An overview**. Boletin de Proteccion Forestal 4: 11-16. Corporacion Nacional de Investigacion y Fomento Forestal, Colombia.

An overview of insect pests and plant pathogens occurring on teak and *Gmelina arborea*, with special attention to potential problems in Central America.

2573 Prasad, R; Jamaluddin. 1989. **Observations on the problem of teak mortality in central India**. Journal of Tropical Forestry 5: 72-75.

Go top

Drought, Pollution and Growth Stress

2574 **Damage to teak by drought in the Panch Mahals of Bombay Presidencey**. Indian Forester 29(7), 1903: 263-266; 31, 1905: p686.

Drought in the division has killed or damaged nearly 45 percentage of standing trees and in some forests 90 percentage affected and causes of death due to soil and critical moisture depth are examined.

2575 Bakshi, B.K; Boyce, J.S. 1959. **Water blister in teak**. Indian Forester 85(10): 589-591.

Water blister disease in teak is noted in certain plantations along rivers in Nilambur, Kerala. It is characterized by profuse exudation of light yellow sap from stem near ground level. It is suggested not to plant teak on very moist sites where water blister develops.

2576 Catinot, R. 1970. **Defects of stem form in teak in Dahomey, and a theory to explain their origin**. (French). Bois et Forests des Tropiques 132: 3-22.

Many stems in teak plantations established in Dahomey contain lumps and flutes and is attributed to the marginal rainfall, the occurrence of a short dry season at flowering time and inadequate rooting in some leached soils.

2577 Fischer, C.E.C. 1914. **Stone found in heart of a teak tree**. Indian Forester 40(7): p372.

The chemical composition of a concretionary stone found in the heart of a teak tree extracted from Tekkadi forests of South Coimbatore is given.

2578 Gueneau, P; Chardin, A. 1973. **Growth stresses**. (French; English). Cahiers Scientifiques, Centre Technique Forestier Tropical 3: 52p.

2579 Kallarackal, J; Bhat, K.V; Seethalakshmi, K.K. 1997. **Water blister problem of teak in Kerala**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 124-128. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

An investigation was undertaken to study the possible causes for development of water blister, and the nature and extent of the resultant damage to the timber.

2580 Kallarackal, J; Seethalakshmi, K.K; Bhat, K.V. 1992. **Water blisters in teak**. KFRI Research Report 82: 22p. Kerala Forest Research Institute, Peechi, Trichur.

Studies are reported on occurrence, symptoms and damage caused to the wood of teak trees at several sites in Kerala by water blisters.

2581 Kubler, H. 1987. **Growth stress in trees and related wood properties**. Forestry Abstracts: 131-189.

2582 Kulkarni, H.D; Dharmaswamy, S.S; Srimathi, R.A. 1987 . **Peculiar trees of teak at Nilambur, Kerala**. Myforest 23(2): 75-76.

Reported the three types of peculiarities observed in 30-141 yr old plantations. The peculiarities were pits, regular undulating swellings over the length of the bole and irregular bulging caused by false knots from epicormic buds.

2583 Narayanamurti, D; Gupta, R.C. 1961. **Swelling pressure of wood**. (German; English). Journal Japanese Society for Testing Materials 10(92): 434-438.

Results of the tests made on about eighty species of Indian woods including teak were presented. Test methods and equipment were described.

2584 Narayanamurti, D; Jain, N.C; Gupta, R.C. 1963. **Growth stresses in trees**. (English; German; French). Silvae Genetica 12(3): 89-99.

Presents the results of experiments on discs of teak showing water-blister symptoms.

2585 Rosso, F; Ninin, P. 1998. **Variability of log defects in teak (*Tectona grandis* Linn.f.) growing at different densities in the Experimental Unit of Ticoporo Forest Reserve, Barinas, Venezuela**. (Spanish). Revista Forestal Venezolana 42(2): 103-112.

Frequency of knots, eccentricity, flattening and bowing were studied in relation to diameter class and stem height for different densities of trees.

2586 Suwanwaree, P. 1994. **Effects of sulfur dioxide on sulphur accumulation and anatomical change of plants on high terrain or Mae Moh's project area, Changwat, Lampang**. Kasetsart University, Bangkok: 113 leaves.

Higher sulfur content in plants was appeared in rainy season while lower content was detected in dry season. Leaf tissue accumulated sulfur more than stem tissue. Plants adapted themselves by increasing in size of upper and lower epidermal cells, palisade cells, spong cell layer and guard cell number of leaf and sulphur content in both leaf and stem tissue significantly.

2587 Wolff von Wulfing, H.E. 1923. **Damage to the trunks of young teak (*Tectona grandis* Linn.f.) caused by tearing off of branches**. Tectona 16(7): 628-635; Korte Meded Proefsta Boschw 5: 8p.

Teak leaves used for wrapping caused damage either by direct picking or by tearing of small branches, at the beginning of wet monsoon. This causes appreciable damage to the trunks, and the paper describes some forms of damage.

2588 Zwart, W. 1938. **The distribution of knotty teak**. Tectona 31: 927-928.

Go top

Forest Fire

2589 **Fire protection in teak forests of Burma**. Indian Forester 30(9), 1904: 414-419.

2590 **Fire protection in teak forests of Burma-1**. Indian Forester 30(11), 1904: 514-515.

2591 **A summary of the observed results of fire protection in teak forests**. Indian Forester 31(8), 1905: 421-424.

The experience in the past and observations made on fire protection are summarised. Fire remove heavy covering of leaves and herbaceous growth, hastens germination, enhance more vigorous growth and suppression of poles and saplings.

2592 **Fire protection in the teak forests of Burma-II**. Indian Forester 31(3): 146-147; 31(4), 1905: 208-211.

Discussing the general view that fire protection is harmful to natural regeneration, the author advocates controlling and use of fire for establishing already existing natural regeneration of teak in Burma.

2593 Altona, T. 1926. **Kangkoengan *Ipomea carnea* and its value to make fire protecting strips around teak plantation**. (Indonesian; English). Tectona 19: 124-134.

The plant is suited for the purpose of fire protection around teak plantation.

2594 Ansep, T.T. 1925. **Effect of firing young teak**. Indian Forester 51(1): 46-47.

Reports an experiment in Chikkanji North, Malabar, wherein area is clearfelled, burnt and teak seed is dibbled when plants are 6" to 35" height, the plantation was burnt and teak stems burnt, prolific shoots came out in a week, later thinned to one per stool after one month. In six months the shoots are 3 to 10 ft. high and healthy.

2595 Balagopalan, M. 1992. **Impact of fire on soil nutrient status in different forest ecosystems of Kulamav, Kerala**. National Seminar on Forest Fires, Trivandrum 29-30 September 1992.

2596 Bloch, P. 1951. **Fire damage in the deciduous forests of North Thailand**. FAO, Rome: 12p.

It has been shown that forest fire destroy or damage greater part of teak trees, aggravate erosion and retard the growth. Fire damage repeatedly affects the increment seriously and makes the forests unproductive. The effect of shifting cultivation and incendiary fires on teak forests of Siam are discussed.

2597 Branthwaite, F.J. 1905. **Fire protection in teak forests of Burma**. Indian Forester 31(7): 383-385.

2598 Burger. 1921. **Has fire protection been stopped in teak forests of Burma**. (Indonesian; English). Tectona 14: 639-642.

2599 Carter, H. 1904. **Fire protection in teak forests of Burma**. Indian Forester 30(8): 363-366.

2600 Dommers. 1909. **Forest fires as the principal cause of the rapid deterioration of our forest soils**. Tectona 2: p373.

2601 Fischer, C.E.C. 1913. **Damage to teak by fire**. Indian Forester 39(9): p434.

Illustrates the injury by fire to teak in a fire-protected forest from Punachi working circle, Annamalai Hills, South Coimbatore Division.

2602 Fischer, W.R. 1905. **Fire protection in teak forests of Burma**. Indian Forester 31(7): 385-387.

2603 Florence, L.M; Methven, I.R. 1994. **Fire behavior, fire effects and survival responses of trees**. Sylvatrop 4(2): 41-63.

Stands of different species including *Tectona grandis* with understorey grasses were subjected to three levels of fire intensity treatments. Survival responses and damage to tree seedlings and saplings by fire were influenced by fire intensity, tree species and diameter size. The success of reforestation on fire-prone grasslands can be facilitated by the use of prescribed fire and the selection of appropriate tree species.

2604 Gleadow, F. 1904. **Fire protection in the teak forests of Lower-Burma**. Indian Forester 30(5): 470-471.

2605 Hewetson, C.E. 1950. **Seventy-five years of fire protection in the tropics**. Empire Forestry Review 29(4): 339-350.

The scientific principles of application of fire protection mainly to mixed teak forest. First part describes forest types and the influence of management over 75 years on the composition. Second part gives statistics of growing stock.

2606 Jong, B.D. 1923. **Protection against forest fires in the teak district of Pakalongan-**

Kendal (Java) in 1922. (Indonesian; English). Tectona 16: 137-152.

Fires are considered incendiary are due to carelessness.

2607 Karnik, C.P. 1967. **Effect of fire on the dry deciduous forests of Satpura mountains, India**. Tropical Ecology 8(1/2), 110-116.

The various physiognamic changes are represented in Satpura mountains, and the chemical composition and nutrient status of different soils encountered has been reported.

2608 Kittinanda, S.P. 1971. **Forest fires in teak forests**. (Thai). Proceedings of the Second Forestry Conference, Royal Forest Department, Bangkok R 129: 69-79.

The general condition of forest soils, and their fertility status are discussed.

2609 Komkris, T; Naraballobh, V (et al). 1969. **Effect of fire on soil and water losses at Mae-Hnad forest, Amphur, Ngao, Lampang Province**. Forest Research Bulletin 6: 82p. Kasetsart University, Bangkok.

Study on soil and water losses on burned and unburned plots in four different forests viz. teak plantation, mixed deciduous forest with teak, deciduous dipterocarp forest and mixed deciduous forest with teak on hill side have been made.

2610 Kwe, T. 1904. **Fire protection in the teak forests of Burma**. Indian Forester 30(9): 470-471.

2611 Manson, F.B. 1904. **Fire protection in teak forests of Lower Burma**. Indian Forester 30(4): 155-156.

2612 Murray, C.H. 1961. **Teak and fire in Trinidad**. (English; Spanish). Caribbean Forester 58(3/4): 57-61.

The origin of the fires and their effects on the crop and site are discussed.

2613 Murty, L.S.V. 1954. **Control burning of teak (*Tectona grandis*) plantations**. Silva 34: p17.

2614 Oever, H.Ten. 1910. **Teak growing and forest fires**. Tectona 2: 554-616.

2615 Ogbe, G.A.E. 1956. **Growth of teak after fire in Arakanga plantation**. Nigerian Forest Information Bulletin 32: 2p. Bibliographic Agriculture United States, Department of Agriculture 1956.

2616 Oguntala, A.B. 1989 . **The climatic aspects of the 1982/83 wildfires in Nigeria**. Meteorology and agroforestry. Proceedings of an international workshop on the application of meteorology to agroforestry systems planning and management, Nairobi, 9-13 February 1987: 539-546. W.S. Reifsnyder; T.O. Darnhofer, Eds. International Council for Research in Agroforestry (ICRAF), Nairobi, Kenya.

The forest-fire climates of parts of Nigeria were studied in relation to a fire incidence which destroyed thousands of hectares of forest and farm plantations in different parts of the country during the 1982/83 dry season. After the fire, survival and regeneration of exotic trees including *Tectona grandis* were very high.

2617 Praasterink, H.C. 1911. **The significance of forest fires to our teak forests**. Tectona 4: 829-834; p609.

2618 Ribbontrop, B. 1898. **Forest fires and their effects on reproduction of teak**. Indian Forester 24: 133-135.

2619 Rietz, G. 1989. **The fire hazard of wood**. (German). Holztechnologie 30(5): 236-239; p280.

A survey of the pyrolysis, combustibility and ignitability of wood is made. Data are presented on the oxygen index of various wood species, wood-based products and wood dusts. Teak is ranked first in fire resistance.

2620 Rodger, H. 1907. **The effects of fire in teak forests**. Indian Forester 33(1): 17-18.

2621 Slade, H. 1896. **Too much fire protection in Burma**. Indian Forester 22(5): 172-176.

The desirability of too much fire protection in all classes of teak forests of Burma is discussed and the problems of management are also stressed.

2622 Timmer, P. 1911. **Protection against forest fires in the North Kradenan Forest Division**. Tectona 4: 702-722.

2623 Troup, R.S. 1905. **Fire protection in the teak forests of Burma-I**. Indian Forester 31(3): 138-146.

Reports the results of enumeration of teak seedlings and young poles from two adjoining pieces of forests - one is protected

from fire for many years and other annually burnt.

2624 Troup, R.S. 1905. **Fire protection in the teak forests of Burma-II**. Indian Forester 31(9): 503-505.

2625 Walker, H.C. 1903. **Fire protection in the teak of Lower Burma**. Indian Forester 29: 554-562.

Go top

Damage by Plants, Weeds and Control

(See also 2044)

2626 Alam, M.K. 1984. **A critical review on the biology and control of Loranthaceae with a particular reference to Bangladesh**. Bano Biggyan Patrika 13(1/2): 7-18.

A discussion of the fifteen mistletoe and other parasitic species occurring in Bangladesh which cause serious damage in many important species including *Tectona grandis*.

2627 Ali, M.I.M; Florence, E.J.M. 1987. **A leaf blight of teak mistletoe, *Dendrophthoe falcata*, in Kerala, India**. Transactions of the British Mycological Society 88(2): 275-277.

Leaf blight of *D. falcata* var. *pubescens* caused by the Colletotrichum state of *Glomerella cingulata* is reported. The possibility of using this isolate for the biological control of *D. falcata* is discussed.

2628 Altona, T. 1929. **Damage to teak plantations by *Loranthus* spp**. (Indonesian; English). Tectona 22: 323-352.

Loranthus damage results in decrease of assimilation, consequent smaller development of leaves, diminution of resistance of pests, mutilation of branches or tops, decrease of wood quality and lastly death of teak tree.

2629 Amakiri, M.A. 1983. **Weeds and weed control in a forest plantation in the rainforest zone of Nigeria**. Proceedings of the Second Biannual Conference, West African Weed Science Society: 272-281. West African Weed Science Society, Abidjan, Ivory Coast.

Soil samples from a *Tectona grandis* plantation in which 18 weed spp. were identified.

2630 Anoop, E.V; Kumar, B.M; Abraham, C.T. 1994. **Teak (*Tectona grandis*) growth in response to weed control treatments**. Journal of Tropical Forest Science 6(4): 379-386.

A field experiment was conducted to test the efficacy of seven weed control treatments in young teak plantations in Kerala. Growth measurements were recorded after the first weed control treatment and manual weeding produced rapid height growth.

2631 Balasundaran, M. 1996. **Impact of mistletoe infestation on growth and survival of teak**. Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium, Peechi, 23-26 November 1993: 28-32. K.S.S. Nair; J.K. Sharma; R.V. Varma, Eds. Kerala Forest Research Institute, Peechi.

The parasite retards the growth of trees and also affects the physical properties of wood and severely infested trees dry up gradually.

2632 Balasundaran, M; Ali, M.I.M. 1989. **Control of teak mistletoe through trunk injection of chemicals**. KFRI Research Report 59: 10p. Kerala Forest Research Institute, Peechi.

The study of the possible control of teak mistletoe in Kerala has suggested infusion of suitable weedicides into the trunk as a possible method for selective killing of mistletoe without harming teak trees. Metribuzin infused into parasite-infected trees.

2633 Balasundaran, M; Ali, M.I.M. 1997. **Mistletoe problem of teak and its control measures**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 118-121. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department and Kerala Forest Research Institute, Peechi.

A preliminary study on the phenology and distribution of the parasite in Kerala and severity of infection in Nilambur Forest Division had been carried out. It is found that the percentage of infestation was 47 to 86 percent and the increment loss due to the parasite infestation was 37 to 42 percent over non-infested trees.

2634 Beeson, C.F.C; Chatterjee, P.N. 1940. **Possibilities of control of Lantana by indigenous**

insect pests. Indian Forest Records (n.s) Entomology 6(3): 58p.

2635 Biswas, S; Chandra, S. 1992. **An observation on teak (*Tectona grandis* Linn.f.) as a phorophyte**. Indian Forester 118(11): p871.

During a study of the epiphytic flora of New Forest, Dehra Dun, Indian teak was found acting as a phorophyte for several angiosperm species. These included Loranthaceous species such as *Dendrophthoe falcata* and other epiphytes.

2636 Clarson, D; Sudha, P. 1997. **Studies on the weeds infestation and their management in teak plantations**. Indian Forester 123(8): 740-745.

A study undertaken in the teak plantations of Sterling Tree Magnum, at various locations in Tamil Nadu, showed that grasses such as *Cynodon* and *Cyperus* spp. were the dominant weed species found.

2637 Coster, C. 1932. **Some observations on the growth of alang-alang (*Imperata cylindrica* Beauv.) in teak forests and its extermination**. Tectona 25(4): 383-402.

Grass is considered harmful to teak plantations as a root competitor. It is highly fire resistant and with quick growth rate it is harmful to teak as a small piece of rhizome can rejuvenate and infest the whole plantation.

2638 Daryono, H; Hamzah, Z. 1979. **A study of *Eupatorium odoratum* as a weed in teak (*Tectona grandis*) forest**. (Indonesian). Laporan, Lembaga Penelitian Hasil Hutan 312: 25p.

Biomass, nutrient content, transpiration and effects of *Eupatorium odoratum* on the growth of teak were studied.

2639 Etuk, E.I. 1973. **A preliminary survey of the weeds in teak plantations in the Western State of Nigeria**. Obeche 8-9: 37-48.

A preliminary survey of weeds in *Tectona grandis* plantations in two vegetation zones in Nigeria, viz. tropical rain forest and derived savanna is made. Twenty five weed species are listed from the plantations in tropical rain forest and six from those in savanna.

2640 Forest Department, Madras. 1942. **On control of *Loranthus* in teak plantations**. Annual Report on Silvicultural Research in the Madras Presidency for the year 1940-41: p84.

Control of *Loranthus* in teak plantations was brought about by cutting the affected branches and laying the cut branches in an open space where they dried up without producing flowers or fruit.

2641 Forest Department, Trinidad and Tobago. 1954. **Mistletoe on teak in Trinidad**. Report of Forest Department, Trinidad and Tobago 1952: 10p.

Many species of Loranthaceae occur but only two are serious parasites of teak. The parasite is cut out from young teak plantations during the leafless period and at the same time all infested trees are cut in a 1/4 mile strip all round the teak in the surrounding forest. The attack appears to be more severe on poor soils.

2642 Forest Research Institute, Dehra Dun. 1949. **Effect of Lantana on teak**. Forest Research in India and Burma 1948-49 Part II: p36.

Wyanad experiments indicated a significant lower volume increment with dense growth of Lantana.

2643 George, K. 1966. **Selective control of *Loranthus* on teak**. (Afrikaans; Persian; Bulgarian). Current Science 35(17): p444.

Tests showed the efficacy of 1:1-dimethyl 4:4-bipyridylium spray applied in early summer when the teak is leafless.

2644 Ghosh, S.K; Balasundaran, M. 1980. **A simple technique for injecting chemicals into teak**. Current Science 49(21): 827-828.

The technique, demonstrated using rhodamine B dye, has been developed to control the parasitic angiosperm *Dendrophthoe falcata* var. *pubescens* in India.

2645 Ghosh, S.K; Balasundaran, M; Ali, M.I.M. 1982. **Chemical control of *Dendrophthoe falcata* on teak through trunk injection: A preliminary field study**. Current Science 51(23): p1119.

Aqueous solutions of various herbicides were infused into trees in a plantation using a cheap injection technique developed earlier.

2646 Ghosh, S.K; Balasundaran, M; Ali, M.I.M. 1983. **Possible teak mistletoe control through trunk-injection of weedicide**. Proceedings of the 10th International Congress of Plant Protection 1067. British Crop Protection Council, Croydon, UK.

In trials in teak plantations using locally manufactured injection equipment, metribuzin provided control of mistletoe. Gramoxone (paraquat), Afalon (linuron), Tolkan (dinoterb + isoproturon) and dalapon were also found active against mistletoe.

2647 Ghosh, S.K; Balasundaran, M; Ali, M.I.M. 1984. **Studies on the host-parasite relationship of phanerogamic parasites(s) on teak and their possible control**. KFRI Research Report 21: 39p. Kerala Forest Research Institute, Peechi.

Studies are reported on the biology of the teak mistletoe, its distribution in Kerala, host species, the phenology of host and parasite, biotic factors and natural enemies, assessment of losses, and management.

2648 Ghosh, S.K; Balasundaran, M; Ali, M.I.M. 1988. **Towards the control of mistletoe on teak through tree injection using weedicides**. Trends in Tree Sciences: 185-192. P.K. Khosla; R.N. Sehgal, Eds. Indian Society of Tree Scientists, Solan.

Dendrophthoe falcata var. *pubescens* Hooks. f. is one of the most destructive parasites on teak plantations in Kerala. The study deals with the development of a technique of trunk injection of teak and screening of weedicides for selective killing of parasite without harm to the host. The technique of tree injection has been perfected using cheap locally fabricated metallic nozzles, distributors, plastic reservoir and dripper set.

2649 Gnanaharan, R; Balasundaran, M. 1997. **Effect of mistletoe attack on teak wood**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 122-123. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

The teak plantations in Kerala are affected by a mistletoe, *Dendrophthoe falcata* var. *pubescens*. The study conducted to assess the effect of mistletoe on teak revealed that wood of mistletoe infested trees had ultimate strength values nearly 14 percent lower than that of non-infested trees. The mistletoe infestation reduced the modulus of elasticity of wood.

2650 Gnanaharan, R; Ghosh, S.K; Balasundaran, M. 1983. **Effect of mistletoe on the strength properties of *Tectona grandis* Linn.f.** Materials und Organismen 18(4): 313-318.

Teak attacked by mistletoe was tested for strength properties. The modulus of rupture and work to maximum load are affected by the parasite attack.

2651 Harley, K.L.S; Kunimoto, R.K. 1969. **Assessment of the suitability of *Plagiohammus spinipennis* (Thoms.) (Col, Cerambycidae) as an agent for control of weeds of the genus *Lantana* (Verbenaceae). I. Life-history and capacity to damage *L. camara* in Hawaii. II. Host specificity**. Bulletin of Entomological Research 58(3/4): 567-574.

Reports field studies in two range areas where the insect has been introduced and found effective biological control of *L. camara*.

2652 Hawksworth, F.G. 1974. **Mistletoes on introduced trees of the world**. United States Department of Agriculture 469: 49p.

All the mistletoes are listed with their hosts and the area of its origin.

2653 Kadambi, K; Dabral, S.N. 1954. **Tests on the efficacy of Fernoxone in killing of various forest trees**. Indian Forester 80(10): 653-658.

On teak trees with diameter range 6.3 to 9.3 inches when given a dose of .5 oz. of Fernoxone, it was ineffective and all these trees sprouted after sometimes.

2654 Kalita, R.K; Chandra, A. 2002. **Natural infestation of mistletoe in various trees in Jorhat District of Assam**. Indian Forester 128(7): 815-816.

A preliminary survey was conducted along village roads in Assam, India to assess the status of mistletoe infestation in areas of Jorhat District. This parasite was observed in eleven tree species which include *Tectona grandis*.

2655 Kallarackal, J; Soman, C.K. 2002. **Ecophysiology of a host parasite relationship in teak**. KFRI Research Report 228. Kerala Forest Research Institute, Peechi.

This document reports the ecophysiological aspects of a host parasite relationship in teak infested with *Dendrophthoe falcata*.

2656 Kallarackal, J; Soman, C.K; Rajesh, N. 2003. **Teak and its canopy parasite *Dendrophthoe* - water relations and ecophysiology**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Teak is widely infested with *Dendrophthoe falcata*. The mistletoe clumps cause enormous reduction in the yield of timber, sometimes leading to the death of the whole tree. This paper explains the ecophysiological factors that help the survival of this parasite.

2657 Koppikar, H.T. 1948. **Control of *Loranthus* pest in forest plantations**. Indian Forester 74(5): p207.

Loranthus is becoming a serious pest of teak plantations. The measures recommended for its control are removal of affected branches and maintenance of an insulating belt of minor forest between the plantations and cultivated ground, gardens, etc.

2658 Kumar, A; Kadam, R.S. 1993. **Control of bamboo in teak plantations and some observations on bamboo flowering**. BIC India Bulletin 3(1): 24-26.

In young teak plantations, bamboo regeneration is found causing stunted growth of teak. Maharashtra Van Sanshodhan Sanstha conducted an experiment to control bamboo growth in such plantations using various treatments which are mentioned in the paper.

2659 Misra, R.M. 1985. **A note on *Leptobyrsa decora* (Hemiptera:Tingitidae) a bio-control agent of *Lantana camara* (Verbenaceae)**. Indian Forester 111(8): 641-644.

During host-specificity tests at Dehra Dun, the insect was found able to complete its full life-history on teak. In view of the likely danger to teak, the whole culture of the insect was destroyed.

2660 Moni, N.S; George, M.P. 1959. ***Eupatorium odoratum* - a common weed found in the teak plantations of Kerala State**. Indian Forester 85(12): 728-730.

All methods of controlling this weed have so far proved to be uneconomic. It is proposed to establish a pilot plant to produce fertilizers from *E. odoratum* for field tests.

2661 Muraleedharan, P.K; Anitha, V. 2000. **The economic impact of *Mikania micrantha* on teak plantations in Kerala**. Indian Journal of Forestry 23(3): 248-251.

A pilot survey conducted to examine the economic impact of *Mikania micrantha* infestation on teak plantations in Kerala showed that *M. micrantha* has increased the cost of planting and has adversely affected the profitability of the plantations and there was a significant difference in the cost of maintenance of teak plantations with and without *M. micrantha*.

2662 Murray, C.H. 1967. **Arboricides and clonal teak**. Commonwealth Forestry Review 46(2): 133-137.

A mixture of 2,4-D and 2,4,5-T applied to control weeds in a teak clone orchard which caused severe injury to the teak.

2663 Nair, P.N. 1973. **The effect of Gramoxone application on *Eupatorium odoratum***. Indian Forester 99(1): 43-48.

Gramoxone treatments were found ineffective and it is concluded that manual weeding is more effective and economical method of control.

2664 Qureshi, I.M. 1956. **Use of chemicals for killing or eradication of weeds**. Proceedings of the 9th Silvicultural Conference, Dehra Dun, 1956, Part 2: 70-71. Forest Research Institute, Dehra Dun.

A brief description of the preliminary experiments in Bombay state in the control of *Loranthus* on teak by injecting the host with $CuSO_4$ and Fernoxone.

2665 Rahman, M.M; Baksha, M.W; Sterringa, J.T. 1993. **Ethological observations of the purple sunbird (*Nectarinia asiatica* Latham): A mistletoe-frequenting bird**. Indian Forester 119(5): 388-394.

The bird eats the fruit of mistletoes parasitic on *Gmelina arborea* and teak and disperses mistletoe seeds in forest plantations. Nectar of *Thevetia peruviana* appears to be a preferred food and it is suggested that planting *T. peruviana* in gamar and teak plantations would minimize dispersal of mistletoe seeds.

2666 Soesilotomo, P.S; Purwadi. 1991. **Methods of abolishing parasitic plants on teak trees in Parengan Forest District**. (Indonesian). Duta Rimba 18(145/146): 7-11.

Methods used for the control of mistletoes on teak in this district of Java are described.

2667 Suharti, M. 1976. **The intensity of *Loranthus* spp. attack on teak stands in Central Java in relation to the age and site classes**. (Indonesian). Laporan, Lembaga Penelitian Hutan 238: 17p.

2668 Suharti, M; Prawira, S.A. 1975. **Mistletoe attack on teak stands in Java**. Laporan, Lembaga Penelitian Hutan 206: 22p.

Descriptions are given of three species of *Loranthus* and *Viscum articulatum* attacking teak in Java. The biology and control of mistletoe are reviewed.

2669 Suharti, M; Sudjud, D.A. 1978. **Experiment on *Mikania micrantha* control with herbicides**. (Indonesian). Laporan, Lembaga Penelitian Hutan 281: 30p.

The climbers *M. cordata* and *M. micrantha* compete with teak for nutrients, space and light and cause mechanical damage to the trees. 2,4-D-amine and glyphosate showed promise in greenhouse.

2670 Tjitrosoedirdjo, S; Umaly, R.C. 1991. **The status of *Chromolaena odorata* (L.) R.M. King and H. Robinson in Indonesia**. Biotrop Special Publication 44: 57-66.

C. odorata is a problem in teak plantations and in pasture and it has become an important weed of perennial crops. Brief notes are given on its control, management and areas of future research.

2671 University of West Indies, Trinidad . 1965. ***Phthirusa adunea* - on *Tectona grandis***. Annual Report, Herbicide Research Unit, 1964: 9p. Regional Research Centre, University of West Indies, Trinidad.

Control of *Phthirusa adunca* parasite on teak, promising results were given by 1 and 5 percent of paraquat and 0.2 percent of 2,4,-D applied by spray.

2672 University of West Indies, Trinidad . 1967. **On control of *Phthirusa aduncea* - a parasite of teak trees**. Annual Report, Herbicide Research Unit 1966: 16p. University of West Indies, Trinidad .

Phthirusa adunca, a parasite of teak trees, was killed by a paraquat at 5 percent concentration.

Go top

Damage by Animals

(See also 1483)

2673 Best, J.W. 1909. **On teak browsing**. Indian Forester 35: p613.

Alludes that stunted and shrubby growth of teak is due to heavy grazing in Bhandra District. But Troup attributes it to hardening of the soil. Heavy grazing is harmful in coppice areas, where coppice shoots are soft and easily broken or trampled down by cattle.

2674 Chacko, K.C; John, C.H. 1999. **Spotted deer menace in young teak plantations**. Evergreen 42: p7.

Dealt with the deer damage in an experimental plantation at the Veluppadam Field Research Centre at Kerala Forest Research Institute.

2675 Deventer, A.J van. 1916. **Measures against wild-grazing in reserved forests**. (Dutch; English). Tectona 9: 83-89.

2676 Forest Department, Sudan. 1950. **Teak in Upper Nile province**. Report of Forest Division, Sudan 1949: 22P. Forest Department, Sudan.

Teak planted north of the Yirrol Road in a light soil was well established in spite of possible elephant damage. At Malwal Chat some trees had been killed by rats and mice tunnelling and gnawing their roots. At Terakikka some teak had been killed by stagnant water collecting in depressions in the clay.

2677 Jayson, E.A. 1986. **Elephant damage in teak plantations**. Evergreen 17: 14-15.

Discussed the damages made by elephants in teak plantations which are classified into four categories such as breaking of branches, breaking of main stem, complete damage and uprooting of trees. Control measures are also suggested.

2678 Jenkins, R.K.B; Corti, G.R; Fanning, E; Roettcher, K. 2002. **Management implications of antelope habitat use in the Kilombero Valley, Tanzania**. Oryx 36(2): 161-169.

High cattle densities, expanding human settlements and the conversion of miombo woodland into farms and teak plantations are found threatening wildlife populations in the Kilombero Valley, Tanzania. The effect of land use change on antelops was investigated in the area of mixed land use.

2679 Jenkins, R.K.B; Roettcher, K; Corti, G. 2003. **The influence of stand age on wildlife habitat use in exotic teak tree (*Tectona grandis*) plantations**. Biodiversity and Conservation 12(5): 975-990.

In the Kilombero Valley, Tanzania miombo wood land is converted into teak plantations and small and private farms. The impact of this habitat change on wildlife populations is poorly assessed. Here assessed the frequency of habitat use of large mammals in teak plantations of different age during the wet season. Areas converted into teak plantations provide suitable habitat for wildlife in the Valley.

2680 Kamalpur, V.R. 1934. **Forking of teak plants**. Indian Forester 60(1): p79.

The author attributes forking to grazing and damage by cattle.

2681 Knoop, W.J. 1915. **Notes on cattle grazing in government forests-with special reference to teak forests of East Toeban forest district**. Tectona 8: 620-640.

2682 Madhavan Pillai, N. 1997. **Elephants and teak plantations**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 251-252. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

A study of the habitat preference by the elephants indicate that the elephants prefer teak plantations rather than evergreen forests with thick undergrowth. Although damage to the teak plantations by the elephants has been reported, it is negligible compared to the vast extent of teak plantations existing in the state.

2683 Meindersma, H.W. 1926. **Cattle grazing in Government teak forests**. (Dutch). Tectona 19: 1070-1071.

2684 Nair, P.V; Jayson, E.A. 1990. **Interaction between elephants and teak plantations in Parambikulam Wildlife Sanctuary**. Proceedings of the Symposium on Ecology, Behaviour and Management of Elephants in Kerala, Trivandrum, 23-24 February 1990: 58-65. Kerala Forest Department, Trivandrum.

This study was conducted at the Parambikulam Wildlife Sanctuary to compare teak plantations of different age with adjoining natural forests in terms of food availability, abundance of animals and damage by wild animals. Animals like gaur, elephant, deer, wild pig and rodents were found in all plantations. Elephants were maximum in three year old plantation. Main damage to the plantations were from elephants.

2685 Pais, A. 1926. **Combating hare and rat attacks in teak plantations**. Indian Forester 52(9): 489-491.

Recommended measures are listed.

2686 Sihler, K. 1924. **Cattle grazing in Government forests**. (Dutch; German; English). Tectona 17: 201-219.

The rights and legal status of natives determine the regulation of grazing in state forests and the author suggests regulation or prohibition gradually of all grazing rights.

Go top

Fungi and Bacteria

(See also 1559, 4480, 4490-4494, 4497-4510, 4518, 4524, 4525, 4528, 4531)

2687 **List of common names of Indian plant diseases**. Indian Journal of Agricultural Sciences 20 (Part-I), 1950: p139.

Lists the following diseases of *Tectona grandis*, brown rust, white spongy-rot, white spongy rot, white sap and heart-rot, white spongy rot, canker and mildew.

2688 Abraham, K.J; Daniel, M; Rai, S.N. 1988. **Phytoalexins and related post-infectional compounds of forest crops of Gujarat**. Advances in Forestry Research in India 1: 191-197.

Analyses were made of pre and post infectional compounds in the leaves of species including teak infected with different pathogenic or non-pathogenic fungi in Gujarat. Flavonoids, phenolic acids and xanthones were all produced following infection. It is suggested that these changes are mechanisms for combating infection. The potential use of these compounds, which are considered to be phytoalexins, is discussed.

2689 Ali, M.I.M; Florence, E.J.M. 1994. **Studies on collar rot of teak seedlings**. Indian Forester 120(1): 69-72.

Symptoms and disease development are briefly described. Describes the results of pathogenicity tests with isolates of the pathogen identified as responsible and of fungicidal evaluation tests in the laboratory.

2690 Altona, T. 1923. **Heart rot in *Tectona grandis* Linn.f.** (Indonesian; English). Tectona 16: 456-473.

The heart rot caused stains in the heartwood, healthy and diseased wood are separated by a dark band. The disease caused probably by a fungus, manifests externally by many adventitious buds, dead tops, and horizontal and vertical clefts appearing in the bark.

2691 Altona, T. 1926. **Damage of teak by *Corticium javanicum* syn. *C. salmonicolor*- Djamoer *oepas***. (Indonesian; English). Tectona 19: 31-53.

Attack leads to the death of branches, shoots or stems in less favorable conditions. Large holes are caused in the bark and the holes penetrate deeply into wood and thus staining and damaging wood by entry of water. Control measures suggested include wide planting distance, early thinning, removal of infested trees etc.

2692 Bagchee, K.D. 1947. **An unrecorded parasite of teak (*Tectona grandis* Linn.f.) reported from Dehra Dun**. Indian Forester 73(7): 332-334.

A disease of young teak trees, characterized by the leaves turning yellow and falling very prematurely and by lesions under the bark, followed by the appearance of pink to red perithecia in the cracks and cavities of the bark.

2693 Bagchee, K.D. 1952. **A review of work on Indian tree diseases and decay of timber and methods of control**. Indian Forester 78(2): 540-546.

A review of the diseases of Indian forest trees including teak and the decay of timber and discusses methods of control.

2694 Bagchee, K.D; Singh, U. 1954. **List of common names of fungi attacking Indian forest trees, timber and the herbaceous and shrubby undergrowths and list of cultures of forest fungi**. Indian Forest Records (n.s) Mycology 1(10): 311-312.

Tectona grandis is one of the 656 species dealt with in the publication.

2695 Bakshi, B.K. 1966. **Root rot of teak**. Nature 210(5038): p784.

Two pathogens, *Polyporus zonalis* and *Peniophora* sp are isolated from teak. *Peniophora* is reported first time on teak. This species colonizes old coppiced stumps and spreads freely through the soil by rhizomorphs which infect healthy roots.

2696 Bakshi, B.K; Singh, S; Singh, U. 1966. **A new root rot disease complex in teak**. Indian Forester 92(9): 566-569.

The pathogens are identified as Polyporus zonalis and Peniophora rhizomorphosulphurea sp.

2697 Balasundaran, M; Sankaran, K.V. 1991. ***Fusarium solani* associated with stem canker and die-back of teak in southern India**. Indian Forester 117(2): 147-149.

The primary symptom was canker development followed by leaf yellowing and shedding and dieback and the causative organism was identified as *Fusarium solani*.

2698 Balasundaran, M; Sharma, J.K; Florence, E.J.M; Mohanan, C. 1995. **Leaf spot diseases of teak and their impact on seedling production in nurseries**. Caring for the Forest Research in a changing world: Proceedings of the 20th World Congress, Tampere, Finland, 6-12 August 1995: p170.

Leaf spot caused by *Phomopsis* sp., *Colletotrichum gloeosporioides, Alternaria* sp. and *Curvularia* sp., leaf rust by *Olivea tectonae* and powdery mildew by *Uncinula tectonae* are the major leaf diseases in nurseries in Kerala.

2699 Banerji, S.N; Bakshi, B.K. 1945. **Studies on the biology of wood-rotting fungi of Bengal**. Journal of Indian Botanical Society 24: 73-92.

This paper gives the geographical distribution, occurrence, effect of light, temperature, humidity and substratum etc. on the growth and cultural character of six fungi including *Polystictus steinhellanus*.

2700 Basak, A.C. 1992. **Bacterial wilt disease of teak seedlings in the forest nurseries and its control**. Bangladesh Journal of Forest Science 21(1/2): 67-68.

The bacterial wilt is caused by *Pseudomonas solanacearum* in Bangladesh.

2701 Batra, L.R. 1964. **Two new ambrosia fungi - *Ascoidea asiatica* and *A. africana***. Mycologia 56(4): 632-636.

A. asiatica sp. nov. was isolated from *Xyleborus velatus* infesting *Tectona grandis* imported from Burma, and *A. africana* sp. nov. from lymexylonid larvae infesting *Chlorophora excelsa* imported from W. Africa.

2702 Bernasco, W. 1908. **Fungal diseases in teak plantations**. (Indonesian; English). Tectona 1(4): 342-343.

2703 Broeker, F.W. 1991. **Discoloration of teakwood due to rust?** Holz Zentralblatt 117(116): p1804.

2704 Chalermpongse, A. 1990. **Introduction to forest pathology in Thailand**. Proceedings of IUFRO Workshop on Pests and Diseases of Forest Plantations, Bangkok, 5-11 June, 1988: 107-113. C. Hutacharern; K.G. MacDicken; M.H. Ivory; K.S.S. Nair, Eds.

The paper summarises information about potentially dangerous forest tree diseases reported in Thailand. Some control measures are also recommended.

2705 Champahaka, U. 1966. **New disease of teak seedlings. A report to the Fifth National Conference of Agriculture and Biology, Bangkok**. Royal Forest Department, Bangkok.

2706 Champahaka, U. 1966. **Report on wilting of teak**. (Thai). Proceedings of the Fifth National Conference of Agricultural Series in plants, Bangkok, Thailand: 6p. Kasetsart University, Bangkok.

Wilting of teak seedlings observed in Tak teak seed orchard is attributed to wilting. The disease is attributed to various fungi.

2707 Chatterji, A.L. 1912. **A new species of mildew**. Indian Forester 38(1): 28-30.

A new fungus identified as *Uncinula tectonae* attacks upper surface of teak leaves giving a bluish appearance to the trees. It probably interferes with the assimilative power of chlorophyll by cutting off light partially.

2708 Chowdhury, K; Khan, S.N. 1990. **Occurrence of soft rot in preservative treated timbers in field tests and outdoor use**. Indian Journal of Forestry 13(4): 345-348.

Studies were made in India on the occurrence of soft rot in preservative treated timbers including teak from graveyard tests. Teak was the most rot-resistant species. A total of 150 isolates belonging to 34 fungi was obtained from the samples.

2709 Coster, C. 1924. **Physiological and pathological kernel formation in teak (*Tectona grandis* Linn.f.)**. (Indonesian; German). Tectona 17: 620-628.

2710 CSIRO. 1984. **Proceedings of the Sixth International Conference on root and butt rots of forest trees, Melbourne, Victoria and Gympie, Queensland, Australia, 25-31 August 1983**. CSIRO and IUFRO Working Party 01, Melbourne, Australia.

The proceedings consists of a number of papers related to the topic in which the following papers are related to teak. 1. Inbreeding, hybridization and conservation in provenances of tropical forest trees. 2. Evaluation of a series of teak and gmelina provenance trials - selection of traits, their assessment and analysis of observations, provenance X environment interaction. 3. Its detection, practical importance and use with particular reference to tropical forestry. 4. Strategies for the incorporation of new provenance material in existing breeding populations of tropical forest trees. 5. Influence of propagation by cuttings on the breeding strategy of forest trees.

2711 Dadwal, V.S; Jamaluddin. 1988. **Role of fungi in weathering of teak fruits**. Indian Forester 114(6): 328-330.

Teak fruits are weathered before use in the nursery in order to promote early germination. Several microorganisms including fungi play an important role in the degradation of the epicarp; microbial activity also loosens the hard mesocarp. Data are tabulated on the percentage of occurrence of 13 fungal species on fresh fruits collected in Mandla Division, Madhya Pradesh.

2712 Dadwal, V.S; Jamaluddin. 1989. **Diseases of teak (*Tectona grandis*) in nursery and plantation and their control**. Seminar on Forest Protection, Dehra Dun, 29-30 June 1989. Forest Research Institute, Dehra Dun.

2713 Dadwal, V.S; Jamaluddin. 2001. **A note on basal canker of teak (*Tectona grandis*) in plantations**. Indian Forester 127(3): 365-366.

This paper describes the symptoms, pathogenicity and control of the basal canker which was caused by a soil-borne pathogen, *Fusarium pallidoroseum* of teak.

2714 Damle, K. 1960 . ***Uncinula tectonae* Salmon on *Tectona grandis* Linn.f.** Journal of Indian Botanical Society 39(2): 243-258.

A study of the morphology, development and cytology of the fungus.

2715 Doo, S.C. 1968. **Bacterial wilt of teak seedlings**. Union Burma Journal of Life Science 1(1): 43-45.

Describes the symptoms of the wilt, which is caused by interruptions of sap flow in the xylem vessels owing to the multiplication and accumulation of bacterial masses. The causal organism was identified as Pseudomonas sp.

2716 Forest Department, Vellore. 1917. **On mixtures and attack of *Hapalia machaeralis* in North Vellore Division**. Inspection Note of Conservator of Forests, Vellore 1921: p729. Forest Department, Vellore.

Reports on the attack of teak trees planted in the midst of mixed forest by *Hapalia machaeralis*.

2717 Gibson, I.A.S. 1975. **Diseases of forest trees widely planted as exotics in the tropics and southern hemisphere. Part 1. Important members of the Myrtaceae, Leguminosae, Verbenaceae and Meliaceae**. 51p. Commonwealth Forestry Institute, Kew, UK; Commonwealth Mycological Institute, Oxford, UK.

Information on tree diseases and damage caused by fungi, bacteria, viruses, algae, parasitic higher plants and nematodes is given, with notes on mycorrhiza and beneficial bacterial associations. Stem, leaf and root diseases, rots and stains and mycorrhiza are discussed separately for important trees including *Tectona grandis*.

2718 Gibson, I.A.S; Corbett, D.C.M. 1964 . **Variation in isolates from *Armillaria* root disease in Nyasaland**. Phytopathology 54(1): 122-123.

Describes certain characters of the fungus infecting plantations including *Tectona grandis*.

2719 Gowda, H.C.H; Naik, S.T. 2002. **Morphological variation in *Ganoderma lucidum* affecting different tree species**. Myforest 38(2): 151-153.

A study was conducted to find out the morphological variation in *Ganoderma lucidum* affecting tree species including teak.

2720 Griffoen, K. 1949. **Some wood-destroying fungi of Indonesia**. (Dutch; English). Tectona 39: 348-367.

The activity of some wood destroying fungi was investigated by means of laboratory test method under controlled conditions on several species of timber specimens including teak. *Polystictus hirsutus* is proved to be the most dangerous.

2721 Hansbrough, J.R (Ed). 1964. **Diseases of widely planted forest trees**. FAO/IUFRO Symposium on Internationally Dangerous Forest Diseases and Insects, Oxford, 1964, FAO/FORPEST 64: 237p.

Includes eighteen papers summarizing information on the major pathogens of forest trees including *Tectona grandis*.

2722 Harsh, N.S.K; Rai, B.K; Rai, A. 1994. **Fungi associated with pollen grains and seeds of *Tectona grandis***. Journal of Tropical Forestry 10: 319-321.

2723 Harsh, N.S.K; Tiwari, C.K; Nath, V. 1989. **Foliage diseases in forest nurseries and their control**. Journal of Tropical Forestry 5(1): 66-69.

Symptoms and control methods are briefly reported for foliage diseases caused by fourteen fungal pathogens in the nurseries of Madhya Pradesh. The diseases include leaf spot disease caused by *Phyllosticta tectonae* on *Tectona grandis*.

2724 Harsh, N.S.K; Tiwari, C.K. 1995. **Assessment of damage caused by heart rot in teak in Madhya Pradesh**. Indian Forester 121(6): 540-544 [Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium, Peechi, 23-26 November 1993: 61-65. K.S.S. Nair, J.K. Sharma; R.V. Varma, Eds. Kerala Forest Research Institute, Peechi, 1996].

An appraisal was made of heart rot damage in natural teak forests in Madhya Pradesh. Results showed that 38 to 88 percent of trees were affected by heart rot.

2725 Hart, H.M.J. 1925. **On a root fungus in teak plantations**. (Indonesian; English). Tectona 18: 749-754.

Dying of young teak trees in Java is reported due to a root fungus. Eradication suggested by allowing agriculture and deep cultivation of soil for 2-3 years.

2726 Hocking, D. 1966. **Root rot of teak. 2. Further field observations, with new records of *Armillaria mellea***. East African Agricultural Forest Research Organization, Mycological Note 44: 4p.

The survey of the root rot of teak plantations in Tanzania and Kenya confirmed

that damaging root diseases were present in all areas examined, and that most diseased trees were associated with *Helicobasidium compactum*.

2727 Hocking, D. 1968. **Stem canker and pink stain of teak in Tanzania associated with *Fusarium solani***. Plant Disease Reporter 52(8): 628-629.

F. solani was consistently isolated from collar and stem cankers and from pink-stained wood of mature *Tectona grandis*. Isolates killed seedlings when inoculated in wounds in the bark, the wood under the lesions was pink, and *F. solani* was recovered from the seedlings.

2728 Hocking, D; Jaffer, A.A. 1966. **Field observations on root rot of teak and nursery disorders**. Tropical Pesticides Research Institute, Arusha, Miscellaneous Report 567: 12p.

A survey of diseases of teak in E. Africa showed that nurseries were generally healthy, but on poorly drained sites, showed symptoms of violet root-rot associated with *Helicobasidium compactum*.

2729 Hocking, D; Jaffer, A.A. 1966. **Field observations on root rot of teak and nursery disorders**. East African Agricultural Forest Research Organization, Mycological Note 41: 6p.

Preliminary study suggests that the violet root rot, caused by *Helicobasidium compactum* cause the loss of 100,000 seedlings in a nursery in a poorly drained site in Tanzania. The nursery was moved to a better-drained site and no recurrence has been observed.

2730 Hocking, D; Jaffer, A.A. 1967. **Field observations on root rot of teak in Tanzania**. FAO Plant Protection Bulletin 15(1): 10-14.

Patches of root rot were found in newly established plantations and the disease was spreading at a rate of 12-18 ft. per annum. The probable cause of root rot is *Helicobasidium compactum*, favoured by poor drainage.

2731 Hosagoudar, V.B. 2004. **New species, new records and a rare fungus**. Zoos' Print 19(3): 1386-1389.

Deals with an account of five leaf infecting microfungi collected from Kerala, India which include *Sarcinella tectonae* found on *Tectona grandis*.

2732 Imperial Forestry Institute. 1926. **A teak disease (*Corticum javanicum*)**. Imperial Forestry Institute Bulletin 24: p277.

2733 Kalshoven, L.G.E. 1936. **Attack on teak by *Monohammus rusticator***. Tectona 29(11/12): 875-881.

2734 Karadge, B.A; Chavan, P.D; Thite, A.N. 1980. **Changes in phenolic compounds of teak leaves induced by powdery mildew infection**. Indian Phytopathology 33(1): 114-116.

2735 Kawabe, Y; Kamizore, S; Aihara, H. 2002. **Seedling diseases in large-scale nurseries of the reforestation and extension project in North East Thailand**. Proceedings of the IUFRO FAO workshop on Pest management in tropical forest plantations, Chanthaburi, Thailand 25-29 May 1998. C. Hutacharern; B. Napompeth; G. Allard; F.R. Wylie, Eds. FORSPA Publication 30: 53-58. FAO Regional Office for Asia and the Pacific, Bangkok, Thailand.

Surveys of seedling diseases were carried out in four large-scale nurseries in the Northeast of Thailand and the disease include rust of *Tectona grandis*.

2736 Khan, A.H. 1951. **Some diseases observed in the teak plantations of East Bengal**. Pakistan Journal of Forestry 1(3): 209-212.

Notes on rust caused by *Uredo tectonae*, and a root rot caused by an unidentified *Polyporus* sp.

2737 Khan, A.H. 1952. **Wood rotting fungi of Pakistan and their control**. Pakistan Journal of Science 4(2): 65-69.

Lists *Irpex flavus* kl. as a fungus attacking *Tectona grandis*.

2738 Khan, M.A.W. 1964. **Root rot and patch mortality disease in equatorial teak of the Sudan**. FAO/IUFRO Symposium on Internationally Dangerous Forest Diseases and Insects, Oxford 1964.

2739 Kobayashi, T. 1985. **Diseases in tropical forest nurseries (4) Rust**. Tropical Forestry 4: 56-59.

The range of tree species susceptible to rusts, the various species of fungi involved and symptoms are discussed. Discussed rust diseases of teak and *Cedrela*.

2740 Kulkarni, S; Siddaramaiah, A.L. 1979. **Chemical control of powdery mildew of teak**. Current Research 8(11): 192-193.

Sulphur dust was found the most effective in controlling *Uncinula tectona* on 2-yr-old seedlings followed by Baycor, Morestan and Calixin.

2741 Lee, S.S; Maziah, Z. 2001. **History of forest pathology research in Peninsular Malaysia and challenges for the future**. Tropical Forestry Research in the New Millennium: Meeting Demands and Challenges. Proceedings of the International Conference on Forestry and Forest Products Research, 1-3 October 2001, Kuala Lumpur, Malaysia: 210-217. Forest Research Institute Malaysia, Kuala Lumpur.

Challenges in studying the diseases of forest tree species in the country are discussed.

2742 Liao, K.F; Peng, S.F. 1991. **Decay durability of wood material for housing**. Forest Products Industries 10(1): 51-67.

Resistance to decay by *Coriolus versicolor* and *Fomes pinicolor* was tested for copper chrome arsenic-treated and untreated samples of *Tectona grandis*.

2743 Machek, L; Derksen, A.M; Alvarez, R.S. 1997. **Assessment of wood decay in small-scale unsterile soil-bed tests**. International Research Group on Wood Preservation, Sweden, 25-30 May 1997, Document No. 97-20111: 10p.

2744 Machek, L; Militz, H; Sierra-Alvarez, R. 2001. **The use of an acoustic technique to assess wood decay in laboratory soil-bed tests**. Wood Science and Technology 34(6): 467-472.

This study assesses the changes in elastic behaviour and mass loss of different hardwood which include teak exposed to decay in laboratory soil-bed tests. The study shows a high correlation between dynamic and static bending measurements for the species tested at different stages of fungal decay.

2745 Maheswarappa, V; Naik, S.T. 2003. **Studies on rust of teak - inoculation and survival of uredospore**. Journal of Agricultural Science, Karnataka 16(1): 144-146.

2746 Maziah, Z; See, L.S. 1999. **Diseases and disturbance of teak seedlings and plantations in Peninsular Malaysia**. (Malay). FRIM Technical Information Handbook 26: 20p. Forest Research Institute Malaysia, Kuala Lumpur.

An account is given of fungal and bacterial diseases of teak in Peninsular Malaysia.

2747 Mehrotra, M.D. 1996. **Some destructive nursery diseases and their management**. Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium, Peechi, 23-26 November 1993: 143-152. K.S.S. Nair; J.K. Sharma; R.V. Varma, Eds. Kerala Forest Research Institute, Peechi.

Disease surveys were conducted in forest nurseries established under social forestry, farm forestry and agroforestry in western Uttar Pradesh and Haryana States. The species covered include *Tectona grandis*. Chemotherapy was found to be helpful in controlling the serious diseases and minimising the damage to the nursery stock.

2748 Mitchell, B.A. 1962. **Bacterial wilt in teak, *Tectona grandis* Linn.f.** Malaysian Forester 25(2): 164-166.

Records the outbreaks of wilt in teak seedlings in nurseries in Kedah and Perlis. Improved drainage and reduced weeding and soil cultivation are recommended as preventive measures.

2749 Mohanan, C; Ratheesh, N; Laya P.Nair; Rajesh Kumar. 2003. **Disease problems and their management in teak root trainer nurseries Kerala, India**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

A disease survey was carried out in central nurseries in the state and root trainer nurseries raised by KFRI. The study revealed that root trainer seedlings were almost free from soil-borne fungal diseases like damping-off, web blight, seedling blight, wilt, collar rot, etc. which were most prevalent in conventional nurseries and caused severe damage to the seedling crop. The common nursery pathogens of teak like *Rhizoctonia solani*, *Pythium* spp., *Fusarium* spp., *Sclerotium rolfsii*, etc. seldom recorded in root trainers.

2750 Mohanan, C; Sharma, J.K; Florence, E.J.M. 1997. **Nursery diseases of teak in India**. Teak: Proceedings of the International Teak

Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 107-113. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Poor seedling emergence continues to be the major constrain in teak nurseries. Seedling collar rot and wilt caused by *Pseudomonas solanacearum* are the most important diseases recently reported from Kerala. Foliage rust caused by *Olivea tectonae* is widespread in teak nurseries. Severe rust infection causes leaf blight and premature defoliation and consequently affects the seedling growth. The paper discusses the current status of teak nursery diseases in India and suggests possible control measures and nursery techniques to be adopted for raising healthy teak seedling.

2751 Momoh, Z.O. 1973. **The root rot of teak (*Tectona grandis*) and its control**. Savanna Series, Federal Department of Forest Research, Nigeria, Research Paper 15: 17p.

Discusses measures to control attack by *Rigidoporus lignosus* in young teak plantations in Nigeria, and reports promising results of applying 2 percent Tillex fungicide to the root-collars of affected trees.

2752 Momoh, Z.O. 1976. **Status of root rot disease of teak (*Tectona grandis* Linn.f.) in Nigeria**. PANS 22(1): 43-48.

Root disease is caused by *Rigidoporus lignosus*, sporocarps of which have been found in the infected plantations. Disease incidence is more serious in shallow lateritic soils and sites with impeded drainage. Disease can be largely reduced by careful site selection and pre-treatment of stumps left behind after land clearing.

2753 Momoh, Z.O; Esuruoso, O.F. 1975. **The root rot of teak (*Tectona grandis* Linn.f.) in Nigeria: A survey for the disease**. Nigerian Journal of Forest Research 5(1/2): 42-46.

2754 Momoh, Z.O; Odeyinde, M.A. 1977. **The control of the root rot disease of teak (*Tectona grandis* Linn.f.) in Nigeria**. Forest Series, Forestry Research Institute of Nigeria, Research Paper 34: 16p.

After application of 2 percent Tillex to the root collars of all dead trees, after digging away the surface soil, resulted in a significant reduction in the disease.

2755 Mulder, J.L; Gibson, I.A.S. 1973. ***Olivea tectonae***. CMI Descriptions of Pathogenic Fungi and Bacteria 365: 2p.

The fungus causes a leaf rust of teak.

2756 Neergaard, P. 1977. **Seed pathology Vol.1**. The Macmillan Press Limited, London.

2757 Nema, A.G. 1992. **Bacterial wilt of teak (*Tectona grandis* Linn.f.) in Madhya Pradesh**. JNKVV Research Journal 26(2): p77.

Seedlings of teak displaying wilt symptoms were collected in a survey of forest nurseries in Madhya Pradesh. The causal agent of this disease was identified as *Pseudomonas tectonae*.

2758 Odeyinde, M.A. 1973. **Assessing forest disease problems**. Federal Department of Forest Research, Nigeria, Research Paper Forest Series 15: 5p.

Discusses the problem of assessing and evaluating a forest disease problem, with particular reference to root and butt rot of teak.

2759 Pande, A; Rao, V.G. 1995. **The genus *Rosellinia* (Sphaeriales) from Peninsular India**. Czech Mycology 48(3): 177-182.

Reported the new record of *Rosellinia dimidiata* on *Tectona grandis* from India.

2760 Pawsey, R.G. 1970. **Forest diseases in Trinidad and Tobago with some observations in Jamaica**. Commonwealth Forestry Review 49(1): 64-77.

Gives a general account of forest diseases in Trinidad and Tobago which include those of *Tectona grandis*.

2761 Pegler, D.N; Waterston, J.M. 1968. ***Rigidoporus zonalis***. C.M.I. Descriptions of Pathogenic Fungi and Bacteria, London 200: p2.

Causes white pocket rot of different species including *Tectona grandis*.

2762 Prasad, V; Pant, D.C. 1999. **Two new records of sarcoscyphaceous fungi from India**. Journal of Mycopathological Research 37(1): 9-11.

Acervus epispartius was found for the first time in India on wet manured soil mixed with forest litter under pure teak forest.

2763 Ramakrishnan, T.S; Ramakrishnan, K. 1949. ***Chaconia tectonae* Ramakrishnan T.S. and K. sp. nov. on teak**. Indian Phytopathology 2(1): 17-19.

Describes a new rust commonly found on *Tectona grandis* in the forests of Malabar and Coimbatore.

2764 Ramesh, K.R. 2000. **Inhibition of *Rhizoctonia solani* the causal agent for collar rot of teak (*Tectona grandis*) seedlings by fungicides and biocontrol agents in *in vitro* conditions**. Indian Forester 126(3): 284-288.

Among the fungicides, chlorothalonil, methoxyethyl mercury chloride and carbendazim were found the most effective in inhibiting fungal growth. Of the 2 biocontrol agents T. viride MNT-7, followed by T. viride MNT-2, were found the most effective in inhibiting the pathogen growth.

2765 Ramesh, K.R. 2002. **Collar rot disease caused by *Rhizoctonia solani* in teak (*Tectona grandis* Linn.f.) - a new record from the nurseries of Tamil Nadu**. Indian Journal of Forestry 25(1/2): 87-88.

Collar rot in the seedlings of teak, a serious nursery disease caused by *Rhizoctonia solani* anamorph of *Thanatephorus cucumeris* is recorded for the first time from Tamil Nadu. An account is given on the disease symptoms, pathogenicity test and isolation of casual organism.

2766 Ramesh, K.R. 2002. **Control of collar rot of teak seedlings by some selected fungicides and biocontrol agents through soil application**. Indian Journal of Forestry 25(1/2): 154-157.

Chemical and biological control of collar rot disease of teak caused by *Rhizoctonia solani* anamorph of *Thantephorus cucumeris* is discussed in this paper. Emisan-6, Indofil M-45 and Bavistin were found effective in controlling the disease. Biocontrol agents Trichoderma viride MNT-7 also found to be effective.

2767 Ramesh, K.R. 2002. **Studies on the control of collar rot disease caused by *Rhizoctonia solani* in teak (*Tectona grandis*) by seed treatment**. Journal of Tropical Forest Science 14(3): 357-363.

Seed treatment with fungicides Emisan-6, Indofil M-45 or Bavistin reduced the collar rot of teak seedlings. Biological control agent Trichoderma viride MNT-7 reduced the collar rot disease.

2768 Rao, R; Modak, C.D. 1974. **Saprophytic fungi on *Tectona grandis* Linn.f.** Journal of the University of Poona, Science and Technology 46: 111-114.

2769 Roldan, F.E; Andres, P.P. 1953. **Bacterial wilt of teak seedlings (*Tectona grandis* Linn.f.)**. Philippine Journal of Forestry 9(1/4): 133-143.

A description of the disease is given. The causal organism is provisionally named *Pseudomonas tectonae* sp. nov.

2770 Saksena, S.B; Vyas, K.M; Saxena, R.K. 1974. **Physiology of *Tectona grandis* leaves infected with *Uncinula tectonae* Salmon**. Journal of the Indian Botanical Society 53(3/4): 265-270.

The effects of pathogenesis on free amino acids, sugars and organic acid contents of teak leaves are described and the results discussed.

2771 Salmiah, U; Jones, E.B.G. 2001. **Occurrence of wood inhabiting fungi in forests of Peninsular Malaysia**. Journal of Tropical Forest Science 13(2): 237-245.

Species richness indices showed that Pasoh Forest Reserve had the highest diversity of wood decay mycota followed by FRIM, Jeram Lenang, Kemasul, Mata Ayer and Ulu Sedili. Some wood decaying fungi occurred on the wide range of woody substrata which included twigs, branches and trunks.

2772 Salmiah, U; Jones, E.B.G; Watling, R. 2002. **The distribution of wood inhabiting fungi in Peninsular Malaysia**. Journal of Tropical Forest Science 14(4): 433-440.

A total of 54 species assigned to 29 genera was recorded. *Earliella scabrosa, Lenzites elegans, Microporus xanthopus, Pycnoporus sanguineus, Schizophyllum commune* and *Trametes feei* were amongst the wood-inhabiting fungi present at all sites examined.

2773 Sharma, J.K; Florence, E.J.M; Mohanan, C. 1997. **Current status of diseases in teak plantations in India and future research needs**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 100-106. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

The current status of diseases in teak plantations in India is evaluated under three broad categories viz., diseases of wider occurrence, serious diseases of restricted occurrence and potentially serious diseases. Future research needs which may fulfill the existing gaps in information and importance of monitoring the disease situation regularly in managing the plantations are highlighted.

2774 Sharma, J.K; Mohanan, C; Florence, E.J.M. 1984. **Two mycelia sterilia parasitic on foliage of hardwood seedlings in Kerala State, India**. Transactions of the British Mycological Society 83(2): 342-343.

Teak is a new host of *Sclerotium rolfsii* which cause leaf spot on teak.

2775 Sharma, J.K; Mohanan, C; Florence, E.J.M. 1985. **Disease survey in nurseries and plantations of forest tree species grown in Kerala**. KFRI Research Report 36: 275p. Kerala Forest Research Institute, Peechi.

Details are given of the occurrence, symptoms, etiology, pathogenicity and control of diseases of forest trees including *Tectona grandis*. The results of the survey are discussed and lists of fungicides evaluated against various pathogens, cultural and morphological characters of fungal and bacterial pathogens, and a list of pathogens and their hosts are appended.

2776 Sharma, V; Mehrotra, M.D. 1992. ***Meloidogyne* spp. - cause of root knot of important forest tree species in nurseries**. Indian Forester 118(12): 961-962.

During forest disease surveys conducted in nurseries in and around Dehra Dun, Uttar Pradesh, root knot nematodes were identified causing galling and poor growth in important tree species including *Tectona grandis*.

2777 Singh, S; Bakshi, B.K. 1964 . **Notes on some Indian tree rusts**. Indian Forester 90(7): 469-472.

Notes on the leaf and pod rusts on Indian trees are given which include *Olivea tectonae* of *Tectona grandis*.

2778 Singh, S; Tewari, R.K. 1970. **Role of a precursor fungus in decay in standing teak**. Indian Forester 96(12): 874-876.

Studied the effect of *Phialophora* sp. on the decay of inner heartwood by *Fomes lividus, Polyporus zonalis* and an unidentifed teak rot fungus.

2779 Soni, K.K; Dadwal, V.S; Jamaluddin. 2004. ***Phomopsis* causing canker in flowering twigs of teak**. TEAKNET Newsletter 32: 1-3.

Reported the canker disease of teak caused by *Phomopsis tectonae* observed in the flowering twigs of teak plantations at Jabalpur and adjoining areas.

2780 Soni, K.K; Jamaluddin. 1998. **Teak nursery diseases**. TEAKNET Newsletter 9: 3-4.

2781 Soni, K.K; Jamaluddin. 2002. ***Amylosporum campbellii* (Berk) Ryv. - a new root rot of teak from India**. TEAKNET Newsletter 27: 5-6.

2782 Srivastava, H.P. 1971. **New records of some Ascomycetes**. Indian Phytopathology 24(4): 828-833.

Records include *Podospora nannopodalis* on teak.

2783 Thirumalachar, M.J. 1949. **Telia of the leaf rust on teak**. Current Science 18(5): 175-177.

The structure of the uredia and telia of teak leaf-rust (*Uredo tectonae*) indicates that it is a species of *Olivea* and the rust is renamed *O. tectonae*.

2784 Thite, A.N; Chavan, P.D; Karadge, B.A. 1980. **Some biochemical changes in teak leaves infected with powdery mildew fungus**. Indian Journal of Mycology and Plant Pathology 10(2): 131-135.

Infection by *Uncinula tectonae* caused considerable decreases in moisture percentage, titratable acidity, total chlorophylls and carbohydrate content. Polyphenol content was increased in infected leaves, and acid phosphatase, amylase and peroxidase activities were stimulated.

2785 Thite, A.N; Patil, C.R. 1985. **Additions to the sooty moulds of Maharashtra - III**. Geophytology 15(1): 82-86.

The fungi described include the new sp. *Clypeolella tectonae* on *Tectona grandis* leaves.

2786 Tiwari, D.P; Rajak, R.C; Nikhra, K.M. 1981. **A new species of *Phomopsis* causing leaf spot disease on *Tectona grandis* Linn.f.** Current Science 50(22): 1002-1003.

P. tectonae is described from teak in Jabalpur causing irregular, greyish brown leaf-spots, with partially embedded pycnidia.

2787 Vanitha, S. 2003. **Occurrence of collar rot of teak caused by *Botryodiplodia theobramae* in Tamil Nadu**. Ecobiol 15(3): p239.

The teak tree was found in sudden wilt and the causal organism of the disease identified as *Botryodiplodia theobromae* at Vinayaga Housing Finance Teak Estate, Hosur, Tamil Nadu.

2788 Yoshimura, M. 1963. **Significance of the interaction between fungal species and test methods in the laboratory decay test**. (Japanese). Journal of Japanese Wood Research Society 9(5): 153-156.

Describes statistically controlled experiments using *Polyporus versicolor* and *Poria monticola* on woods of six tropical species including teak.

Go top

Insect Pests

(See also 0222, 0309, 0831, 3362, 3526, 4129, 4455, 4473, 4475, 4483, 4484, 4506)

2789 **The Tortrix of the teak tree**. Indian Forester 18, 1892: 46-48.

Describes the ravages of attack by larva of a Tortrix in some of the plantations in Burma in 1884, where a complete defoliation of teak was observed.

2790 **Damage to teak logs in ship holds**. Indian Forester 59(1), 1933: 52-53.

The shot hole boring of teak logs attributed to *Dinoderus minutus* is discussed.

2791 **Teak defoliators**. Forest Research in India and Burma 1947/48 Part I, Chapter IV: p38. Government of India Press, New-Delhi, 1948.

2792 **Proceedings of the Fifth Annual Meeting of the Committee for the Protection of Timber against Marine Organisms Attack, Trivandrum, 7-10 March 1960**. Timber Dryers' Preservations Association 6(2), 1960: 1-22.

Includes reports by A. Purushotham outlining the work of Dehra Dun, the Bombay and other Indian wood preservation centres on *Limnoria*, *Teredo* and *Martesia* spp., with particular reference to durability tests on Ascu and creosote treated heartwood specimens of Indian timbers and by A.S. Rawat, summarizing the results of statistical data on toxicity tests with Ascu, creosote, creosote/fuel oil, and PCP preservatives and durability tests on species including *Tectona grandis* at various harbours.

2793 ***Zeuzera coffeae* Nietn. (Lepidoptera, Cossidae) (red twig borer, red Coffee borer)**. Distribution Maps of Pests, A. 313, 1973: 2p.

2794 ***Olivea tectonae* (T.S. and K. Ramakrishnan) Mulder**. Distribution Maps of Plant Diseases 499, 1974: 2p.

On Tectona grandis.

2795 Agboola, D.A; Kadiri, M. 1999. **The effects of defoliation and inorganic fertilisers on the growth of some tropical tree seedlings**. Journal of Tropical Forest Science 11(4): 672-679.

The effects of defoliation and some inorganic fertilizers on the growth of nursery seedlings of tropical tree species including *Tectona grandis* were studied in Nigeria. Seedling height was unaffected by defoliation. An increase in total leaf area and dry weight of seedlings was there when treated with inorganic fertilizers.

2796 Ahmad, M. 1955. **A new termite from East Pakistan (Isoptera, Termitidae)**. Biologia, Lahore 1: 25-27.

Describes a soldier of *Microtermes pakistanicus* sp. nov., found on the bark of teak in the Chittagong Hills.

2797 Ahmad, M. 1989. **Feeding diversity of *Myllocerus viridanus* Fab. (Coleoptera: Curculionidae) from South India**. Indian Forester 115(11): 832-838.

Myllocerus viridanus is a common defoliator of teak in the forests of southern India. It is found that it is causing considerable defoliation to many plant species of forestry importance.

2798 Ahmad, M; Vijayachandran, S.N; Choudhury, J.C.B. 1985. **Biology of *Hestiasula brunneriana* Saussure (Dictyoptera: Mantidae)**. Indian Forester 111(5): 333-338.

H. brunneriana seems to be an effective predator on various defoliating insect pests including *Hyblaea puera* and *Eutectona machaeralis*. A study was made of various aspects of its life history.

2799 Aisagbonhi, C.I. 1987. **Damage to teak (*Tectona grandis* Linn.f.) leaves by nymphs of *Zonocerus variegatus* Linn., (Acridoidea: Pyrgomorphidae) at Ibadan, Nigeria.** Nigerian Journal of Entomology 8(1/2): 99-102.

Early-instar nymphs of the acridid *Zonocerus variegatus* are reported skeletonizing the leaves of *Tectona grandis* in Nigeria.

2800 Ali, M.S; Alam, T; Kumar, M; Chatruvedi, O.P. 2002. **Studies on seasonal incidence of *Eutectona machaeralis* Walker on teak seedling stock**. Indian Journal of Agroforestry 4(1): 79-80.

Seasonal incidence and level of infestation caused by different instars of *Eutectona machaeralis* in nursery stock was studied. Rainfall, minimum temperature, relative humidity had significant positive correlation on larval population of the pest on teak seedlings in north Bihar, India.

2801 Ali, M.S; Alam, T; Sattar, A. 2002. **Studies on population fluctuation of *Eutectona machaeralis* Walker on teak saplings in north Bihar**. Shashpa 9(2): 139-142.

Weather and population fluctuation data showed that weather had a significant influence on pest population build-up. Rainfall, minimum temperature and relative humidity had significant positive correlation with pest population.

2802 Ali, M.S; Chaturvedi, O.P. 1996. **Major insect pests of forest trees in north Bihar**. Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium, Peechi, India, 23-26 November 1993: 464-467. K.S.S. Nair; J.K. Sharma; R.V. Varma, Eds. Kerala Forest Research Institute, Peechi.

Insect pests and disease causative pathogens affecting seedlings and plantations of forest trees including *Tectona grandis* are enumerated.

2803 Alphen De Veer, E.J Van. 1956. **The occurrence of *X. destruens* in teak plantations in Java**. (Javanese). Rimba Indonesia 5(7/8): 387-408.

Discusses the nature of the damage to timber. Recommends suspension of teak planting in infested areas and in other areas too wet for teak and research on the effect of thinnings of different intensity and of an understorey of other species.

2804 Altona, T. 1925. **Damage to teak plantations by ants**. (Indonesian; English). Tectona 18: 755-762.

In the island of Java, young teak trees are observed to be damaged by ant living in trees, *Crematogaster traubi* var.*vastatrix*. The young shoots of leaf stalks are punctured and the pith is digged out causing the death of the young organs.

2805 Amin, P.W; Upadhyaya, A.K. 1976. **Occurrence of teak defoliator, *Hyblaea puera* (Hyblaeidae, Lepidoptera) on the Fountain Tree *Spathodea campanulata* (Bignoniaceae)**. Indian Forester 102(5): 306-311.

The life cycle, host preference and interbreeding were studied. It is concluded that the populations on *S. campanulata* and teak were identical. *S. campanulata*, which is a new host record for *H. puera*.

2806 Amir, M. 1977. **The effect of temperature on the distribution of the teak pest *Neotermes tectonae* Damm. in Java**. (Indonesian). Proceedings of the Fourth Biological Seminar and Second Biological Congress, 10-12 July 1975. Vol. 2: 265-270.

2807 Andrews, E.A. 1920. **Insect pests of tea in North East India during season, 1919**. Indian Tea Association Quarterly Journal 2: 33-34.

Reports on the insect *Zeuzera coffeae* which attacks teak tree also in addition to the tea.

2808 Andrews, E.A. 1921. **Insect pests on tea in North India during the season 1920**. Indian Tea Association Quarterly Journal 1(6).

Reports on the life history and occurrence of the insect *Zeuzera coffeae* which attacks teak also.

2809 Angeles Martinez, M de los; Blanco, E; Perez, I. 2001. **New mealybug hosts of *Dysmicoccus ferris* (Hem., Pseudococcidae) genus in Cuba**. Revista de Proteccion Vegetal 16(2/3): p160.

Teak is one of the species recorded as new hosts for the genus *Dysmicoccus* in Cuba.

2810 Anuwongse, B. 1972. **A species of wood-destroying beetle recently found in Thailand**. (Thai). Vanasarn 30(3): 205-215.

Reports the identification of *Stromatium longicorne* infesting structural timbers including teak sapwood. Prevention of attack by treating inferior structural timber with a conventional preservative is recommended.

2811 Arndt, U. 1968. **Intestinal protozoa of *Reticulitermes* and their suitability for testing wood extractives**. (German). Materials und Organizmen 3(2): 119-126.

In an investigation on the physiology of termite nutrition three micro-organisms were isolated from the gut and cultured. Of these include desoxylapachol from teak.

2812 Arreola Vazquez, M.C. 1980. **Forest protection at the Forest Experiment Station 'El Tormento' (Campeche, Mexico)**. (Spanish). Ciencia Forestal 5(24): 49-58.

Pests of young plantations including teak discussed include *Xyleborus morigerus*.

2813 Atkinson, D.J. 1926. **Some types of teak defoliation**. Indian Forester 52(4): 141-146.

Reports on defoliation by the insects *Hapalia machaeralis* and *Hyblaea puera* in Nilambur as teak feeders. Certain types of defoliation characteristic of particular species of insects are described and illustrated. Skeletonization by *Aularche milliaris* and *Diacrisia obliqua* is also reported.

2814 Atkinson, D.J. 1931. **Insect damage to the timber of teak (*Tectona grandis*)**. Burma Forest Bulletin (Zoology Series) 26(2): 1-11.

The damage caused to teak timber by insect species, important of which are dealt with.

2815 Atkinson, D.J. 1936. **A survey of the damage to teak timber by the bee-hole borer *Xyleutes ceramica* Wlk. throughout the main teak-bearing forests of Burma**. Indian Forest Records (n.s.) Entomology 2(1): 1-98.

Results are presented on a prolonged investigation in the incidence of bee-holing in the main teak plantations of Burma.

2816 Atkinson, D.J. 1936. **Further notes on bee-hole borer *Xyleutes ceramica* in India**. Indian Forest Records (n.s) Entomology 5.

2817 Atkinson, D.J. 1936. **On the biology bee-hole borer *Xyleutes ceramica* Wlk. in Burma**. Indian Forest Records (n.s) Entomology 4.

2818 Atkinson, D.J. 1936. **On the biology of *Hapalia machaeralis* Wlk**. Indian Forest Records (n.s) Entomology 6.

2819 Atkinson, D.J. 1937. **Survey of the damage to teak timber by bee-hole borer *Xyleutes ceramica* Wlk. throughout the main teak bearing forests of Burma**. Indian Forest Records (n.s) Entomology 2.

The investigations include the varying incidence of attack and comparison of incidence as between natural and plantation grown stands.

2820 Atuahene, S.K.N. 1976. **Incidence of *Apate* spp. (Coleoptera: Bostrychidae) on young forest plantation species in Ghana**. Ghana Forestry Journal 2: 29-35.

In plantations species including *Tectona grandis* were affected.

2821 Baksha, M.W. 1990. **Some major forest insect pests of Bangladesh and their control**. Forest Research Institute Chittagong, Bulletin Forest Entomology Series 1: 19p.

Brief descriptions are given of the damage caused by and control methods used for the nursery pests, plantation pests and wood and timber pests of Bangladesh.

2822 Baksha, M.W. 1996. **Attack of teak canker grub, *Dihammus cervinus* Hope (Cerambycidae: Coleoptera) and its control in teak plantations of Bangladesh**. Bangladesh Journal of Forest Science 25(1/2): 37-42.

Characteristics are described of infestation by the teak canker grub, *Dihammus cervinus* in teak plantations in Bangladesh, including the nature and extent of damage, geographical distribution, life history, age of host plants, and control measures.

2823 Baksha, M.W; Crawley, M.J. 1995. **Relative preference of different host plants to teak defoliator, *Hyblaea puera* Cram. (Hyblaeidae: Lepidoptera) in Bangladesh**. Bangladesh Journal of Forest Science 24(1): 21-25.

Seven plant species have been recorded as hosts of the teak defoliator, *Hyblaea puera*, in Bangladesh. The food preference of the pest larvae was evaluated and *Tectona grandis* was found to be the most preferred.

2824 Baksha, M.W; Crawley, M.J. 1998. **Effect of defoliation on the growth of teak**. Journal of Tropical Forest Science 10(3): 312-317.

Four years of manual defoliation caused significant losses of about 14-49 percent in height, 19-51 percent in basal area and 23-62 percent in volume increments depending on the intensity of defoliation compared with the unsprayed control. Loss of volume increment is a serious impact of defoliation.

2825 Baksha, M.W; Crawley, M.J. 1998. **Population dynamics of teak defoliator, *Hyblaea puera* Cram. (Lep., Hyblaeidae) in teak plantations of Bangladesh**. Journal of Applied Entomology 122(2/3): 79-83.

The temporal and spatial distribution of infestation suggested a short-range migration of the moth. When general flushing of teak occurs, the population starts building up generation by generation and when a critical density is reached in a patch, the newly emerged moths migrate to newly flushed teak areas. After one to three peaks, the population declines due to leaf maturity, natural enemies or density-dependent food depletion.

2826 Baksha, M.W; Islam, M.R. 1997. **Major defoliators of teak in Bangladesh and their management**. Bulletin Forest Entomology Series, Bangladesh Forest Research Institute 2: 14p. Bangladesh Forest Research Institute, Chittagong, Bangladesh .

2827 Balakrishnan Nair, N. 1956. **Destruction of timber structure by ship worms in Madras waters**. Journal of Scientific and Industrial Research 15c(3): 81-82.

Bankia admondsonii, attacked hulls of boats, jetty constructions, fishing stakes etc. of teak and *Teredo parksi* - attacked piles and other underwater structures of teak inside harbour.

2828 Balu, A; Rajarishi, R; Deeparaj, B; Durairaj, S. 1997. **Curling and crinkling of teak leaves**. Indian Forester 123(8): 775-777.

Nursery seedlings and young trees of teak in Kerala and Tamil Nadu are attacked annually by a species of leaf hopper. In advanced stages of infestation a secondary association of the pest with the fungal leaf pathogen *Phomopsis* was there.

2829 Banerjee, S. 1975. **Inducing sterility in adult moths of *Hapalia machaeralis* Wlk. (Lepid., Pyralidae) by administering metepa through adult diet**. Zeitschrift fur Angewandte Entomologie 79(1): 48-52.

When the chemosterilant metepa was supplied in their food to adults of both sexes of *Pyrausta machaeralis* (Wlk.), metepa did not affect the duration of adult life, but with access to 1.2-2.5 percent there were toxic effects.

2830 Basalingappa, S; Gandhi, M.R. 1994. **Infestation of the seedlings of *Tectona grandis* by the lepidopteran larvae of *Hapalia machaeralis* (Pyralidae) and *Hyblaea puera* (Hyblaeidae).** Journal of Ecobiology 6(1): 67-68.

Observations of a heavy infestation leading in many cases to total leaf loss, are reported from Barachi nursery in the Western Ghats of Karnataka.

2831 Basu, A.C. 1943. **Effect of different foods on the larval and post-larval development of the moth *Prodenia litura* Fab**. Journal of the Bombay Natural History Society 44: 275-280.

2832 Beekman, H; Beumee, J.G.B; Kalshoven, L.G.E. 1919. **Injuries and diseases in trees**. Meded Proefsta Boschw 4: 82p. G. Kolff & Company, Satavia.

Contains information about teak borer, *Duomitus ceramicus*, teak termite, *Calotermes tectonae*, bark injuries, red borer, *Zuezera coffea*, red stem borer, *Zeuzera postexcit*a and ring borer, *Phassus* spp.

2833 Beeson, C.F.C. 1918. **Forest insect conditions in India**. Indian Forester 44(12): 587-591.

Gives notes on Sahayadrassus malabaricus, Hyblaea puera, Hapalia machaeralis and Xyleutes ceramica.

2834 Beeson, C.F.C. 1919. **The food plants of Indian forest insects**. Indian Forester 45(6): 312-323.

Along with other insect lists, *Alcides ludificator*, sapling borer, *Arisobia birmanica, Glenea galathea* and *Glenea indiana*, etc. and several other insects and defoliators.

2835 Beeson, C.F.C. 1920. **Some problems in forest insect control**. Proceedings of Third Entomological Meeting: p696, 704. Government of India, New Delhi.

2836 Beeson, C.F.C. 1921. **Defoliation of teak trees**. Indian Forester 47(6): 269-270.

2837 Beeson, C.F.C. 1921. **Beehole borer of teak. Preliminary note on the ecology and economic status of *Duomitus ceramicus* Wlk. in Burma (Lepidoptera: Cossidae)**. Indian Forest Records 8(3) (Old Series) Entomology: 105p.

2838 Beeson, C.F.C. 1925. **The teak canker grub-*Dihammus cervinus***. Indian Forester 51(5): 187-192.

The paper describes distribution, life history damage caused by the pest and also recommends control measures.

2839 Beeson, C.F.C. 1928. **The defoliation of teak**. Indian Forester 54(4): 204-215.

2840 Beeson, C.F.C. 1930. **Loss of increment in teak defoliation**. Indian Forester 57(11): 540-545.

2841 Beeson, C.F.C. 1931. **Loss of increment in teak defoliation**. Indian Forester 60(10): 672-683.

2842 Beeson, C.F.C. 1941. **The ecology and control of the forest insects of India and the neighbouring countries**. Vasant Press, Dehra Dun: 1007p.

A systematic record of available information on the ecology of insects related to Indian forests. The information is arranged alphabetically by orders and then families of insects, each species is dealt with separately. A brief description is given for each species, a list of hosts, life history and nature of the damage and its economic importance. The second part deals with control. Seven types of control are distinguished, climatic, nutritional, biotic and silvicultural, biological, mechanical and chemical. The last part of the book deals with specific control measures for each type of insect.

2843 Bhowmik, A.K; Vaishampayan, S.M. 1986. **Observations on the activity of teak defoliator *Hyblaea puera* Cramer on teak (*Tectona grandis*) influenced by the movement of monsoon**. Journal of Tropical Forestry 2(1): 27-35.

It is indicated that *H. puera* is a strongly migratory moth and its activity was closely linked with the movement of the SW monsoon. The first appearance of the moth was within 2 days of the arrival of the monsoon. Delay in the arrival of the monsoon in E. Madhya Pradesh reduced pest activity in proportion to the delay.

2844 Bhowmik, A.K; Vaishampayan, S.M. 2001. **Effect of elevation on light trap catches of *Hyblaea puera* Cramer and *Pyrausta machaeralis* Walk. in the teak forest at North Mandla**. JNKVV Research Journal 35(1/2): 87-88.

A light trap was installed 50 m above ground level in Madhya Pradesh to determine the effect of elevation on light trap catches of *Hyblaea puera* and *Pyrausta machaeralis*.

2845 Bigger, M. 1980. ***Hyblaea puera* on teak**. Forest Pests of the Solomon Islands, Forestry Division, Solomon Islands 5: 3p.

A brief account is given of the biology, life cycle, control and distribution of the species. The population is generally kept in check by a number of natural enemies.

2846 Bingham, C.T. 1894. **Note on the pests of a teak tree**. Indian Forester 20: 22-24.

Describes damages caused by insects- *Hyblaea puera* and *Paliga damastesalis* in Burma.

2847 Bourdillon, T.F. 1889. **A teak borer in Travancore**. Indian Forester 15: 252-253.

2848 Bourdillon, T.F. 1898. **Insects attacking teak in Southern India**. Indian Forester 24: 126-127.

2849 Campbell, W.G; McGowan, J.C. 1939. **The composition and origin of a stony deposit found in galleries of the beehole borer in a number of samples of teak wood (*Tectona grandis* Linn.f.)**. Empire Forestry Journal 18(1): 91-94.

The approximate composition of the deposit is 8 percent moisture, 55 percent resinous organic material and 36 percent calcium hydrogen phosphate. The origin of the deposit is probably the tree sap from which water is evaporated.

2850 Canadian Forestry Service, Ontario. 1982. **Effects of insects and diseases on cone and seed storage**. Proceedings of the International Symposium on Forest Tree Seed Storage: 98-135. Canadian Forestry Service, Chalk River, Ontario.

Out of three papers one paper was on teak. Sharma, J.K., Mohanan, C. Spermoplane microflora of stored seeds of *Tectona grandis*, *Bombax ceiba* and *Eucalyptus* spp. in relation to germinability. 107-125.

2851 Cann, F.R. 1939. **A further instance of the occurrence of a stony deposit in insect tunnels in a sample of teak**. Empire Forestry Journal 18: p268.

A stony deposit from tunnels of *Xyleutes ceramica* was found in pin-holes typical of Scolytid and Platypodid boring beetles in a sample of Siamese teak.

2852 Chakravarthy, A.K; Puttarangappa, S. 2003. **Unusual occurrence of teak defoliator on cotton in Southern Karnataka**. Insect Environment 9(3): p119.

It is reported that *Hyblaea puera* is defoliating tender leaves of cotton in Karnataka.

2853 Champion, H.G. 1934. **The effect of defoliation on the increment of teak saplings**. Indian Forest Bulletin 89, 1934: 6p.

The experimental results indicate that the three defoliation in the first season caused sixty to seventy percent loss of the normal increment, and a fourth defoliation increased it to 65-70 percent. Defoliation in the second season caused further loss and reduced power of recovery.

2854 Champion, H.G. 1935. **The effect of defoliation on the increment of teak saplings**. Indian Forester 61(2): p121.

Lepidopterous larvae-*Hapalia machaeralis* and *Hyblaea puera* cause death of saplings from repeated defoliation and skeletonising, but in large trees death rarely occurs. The paper describes and discusses effect of defoliation on increment of teak.

2855 Chang, L; Wu, W.J; Hsu, E.L. 2002. **The food preference of the Formosan subterranean termite, *Coptotermes formosanus* (Isoptera: Rhinotermitidae)**. (Chinese). Plant Protection Bulletin, Taipei 44(2): 135-139.

2856 Chatopadhyay, S. 2000. **Observation on the feeding habit of the teak defoliator, *Hyblaea puera* Cramer (Hyblaeidae: Lepidoptera)**. Journal of Interacademicia 4(1): 183-185.

As a result of heavy infestation 89.68 percent and 91.93 percent of seedlings were of no use in the years 1998 and 1999, respectively. A brief account of the behaviour of *Hyblaea puera* is also given.

2857 Chatterjee, P.N; Sebastian, V.O. 1965. **The feeding habits of larvae of *Hapalia machaeralis*, the teak leaf skeletonizer on the leaves of *Lantana camara* Linn., and a suggestion for evolving a new insecticide**. Indian Forester 91(3): 200-202.

Experiments with larvae of this insect showed that, in the absence of teak leaves, first and second instars refused to eat Lantana leaves, and died of starvation. Some larvae of the third and fourth instars ate Lantana leaves, but most of them died later. It is suggested that further research should be done on the possible insecticidal or repellent constituents in *L. camara* leaves.

2858 Chatterjee, P.N; Sen Sarma, P.K. 1968. **Important current problems of forest entomology in India**. Indian Forester 94(1): 112-117.

The present position of teak defoliation and possible control measures have been discussed.

2859 Chatterjee, S.N. 1932. **Identification of teak defoliators in the field**. Indian Forester 58(12): 689-691.

A note is given to identify the more important defoliators of teak in field.

2860 Chatterjee, S.N. 1941. **On the nomenclature and seasonal forms of *Hapalia machaeralis***. Indian Journal of Entomology 3(2): 177-178.

2861 Chaudhry, G.U. 1954. **Some problems of forest entomology in Pakistan**. Pakistan Journal of Forestry 4(4): 241-251.

Include brief notes on pests of teak also.

2862 Chaudhry, M.I; Ahmad, M; Malik, N.K; Akhtar, M.S; Arshad, M. 1972. **Termites of Pakistan. Identity, distribution and ecological relationship**. 154p. Pakistan Forest Institute, Peshawar, Pakistan.

Observations on the nests, feeding habits and swarming are provided for the species observed and the distribution of some genera is discussed in relation to climate and altitude. In laboratory investigations on the resistance of common timbers to attack by insects, *Tectona grandis* is found highly resistant.

2863 Chavan, M.R; Kumar, P. 1998. **Gall midge, *Asphondylia tectonae* Mani (Cecidomyiidae: Diptera) threat to teak**. Indian Journal of Forestry 21(4): p366.

The occurrence of the gall midge, *Asphondylia tectonae* was observed in a clonal teak seed orchard and in teak plantations around Sirsi in Karnataka. The adult insects and galls are briefly described. Some of the seed orchard clones exhibited resistance to the gall midge while others were 100 percent infested.

2864 Chen, Z.Q; Wu, S.X. 1984. **Preliminary observations on *Hyblaea puera* Cramer**. Insect Knowledge Kunchong Zhishi 21(4): 161-163.

Preliminary observations on the biology of *Hyblaea puera*, an important pest of teak in Guangdong, Yunnan and Hubei Provinces and Taiwan, are described. The egg, larva, nymph and adult are described.

2865 Cheriyan, P.V. 1964. **Vertical distribution of Crustacean and Molluscan wood borers on submerged structures in Cochin harbour**. Journal of Timber Dryers' Preservers Association, India 10(2): 26-36.

Range and intensity of attack by *Martesia* spp., *Sphaeroma* spp., and *Teredo* spp., observed on marine piling of including *Tectona grandis*, after about 5 years service.

2866 Cherrett, J.M; Peregrine, D.J. 1976. **A review of the status of leaf cutting ants and their control**. Association of Applied Biologists: Proceedings of the Association of Applied Biologists. Tropical pests. Annals of Applied Biology 84: 124-128.

Tables are given showing the distribution in the Americas of 14 species of Atta and 23 species of Acromyrmex and the importance of leaf-cutting ants as pests of agriculture, forestry and range plants. Types of plants susceptible to damage by these ants are listed, and information on distribution, crops damaged, economic importance and control are briefly reviewed.

2867 Chey, V.K. 2000. **Insect pests of teak**. Proceedings of the Seminar on High Value Timber Species for Plantation Establishment - Teak and Mahoganies, Sabah, 1-2 December 1998. JIRCAS Working Report 16: 59-66. H.H. Chan; K. Matsumoto, Eds.

The four major insect pests of teak in Sabah are identified as *Xyleutes ceramica*, *Endoclita aroura*, *Paliga damastesalis* and *Hyblaea puera*. The amount of damage and control methods are discussed. It is reported that the trend is to move from sole reliance on chemical control to a more integrated approach incorporating silvicultural, biological, and pheromone attractant measures.

2868 Chey, V.K. 2002. **Major insect pests and their management in forest plantations in Sabah, Malaysia**. Proceedings of the IUFRO FAO workshop on Pest management in tropical forest plantations, Chanthaburi, Thailand, 25-29 May 1998. C. Hutacharern; B. Napompeth; G. Allard; F.R. Wylie, Eds. FORSPA-Publication 30: 19-23. FAO Regional Office for Asia and the Pacific, Bangkok.

The major tree species planted are fast-growing exotics which include *Tectona grandis*. The establishment of these single species plantations is affected by defoliating insects, termites, pinhole borers and cerambycid and cossid stem borers. This paper focuses on the more important insect pests, the damage and control methods.

2869 Chinniah, C; Senguttuvan, T; Varma, R.V. 1998. **Morphometric discrimination of larval instars of teak defoliator, *Hyblaea puera* Cramer**. Insect Environment 4(3): p77.

The head capsule widths of the 5 larval instars of *H. puera* were measured and are given.

2870 Choldumrongkul, S. 1987. **Influence of soil composition and some properties of teak tree on the infestation of teak beehole borer, *Xyleutes ceramics* Walker**. Kasetsart University, Bangkok: 54 leaves.

Studies on the influence of soil composition and some properties of teak tree on the infestation of the teak beehole borer, *Xyleutes ceramics* Walker, were carried out. A total of 18 factors were studied which influence the infestation of the teak beehole borer. The factors were arranged from high to low correlation as follows: pH, alcohol-benzene extractives, G.B.H., manganese, thickness of the teak bark, bark hardness, percentage of clay, calcium and sodium respectively.

2871 Choldumrongkul, S; Hutacharern, C. 1988. **Possibility of using light traps to estimate the population of the teak defoliators**. Thai Journal of Forestry 7(1): 28-36p.

Estimation of the population density of the teak defoliators by using light traps at Khaobin teak forest in Ratchaburi province found the number of *Hyblaea puera* Cramer was much less than *Eutectona machaeralis* Walker. The result indicated that light trap was possible to use as one of the tools to estimate the population of *E. machaeralis*.

2872 Choldumrongkul, S; Polwicha, P. 1992. **Effect of mixed plantation of teak and eucalyptus on the outbreak of teak beehole borer**. Proceedings of the Seminar on 50 Anniversary of Huay-Tak Teak Plantation, Thailand, 5-8 August, 1992. Royal Forestry Department, Bangkok.

Effect of mixed plantation of teak and eucalyptus on the outbreak of teak beehole borer was studied in three plantations. The damage rate and population density were low in the mixed stands and were significantly different from those in the pure stands.

2873 Cobbinah, J.R. 1972. ***Hypothenemus pusillus*, a shoot borer of *Tectona grandis*, *Terminalia invorensis*, *Cedrela odorata* and *Gmelina arborea***. Ghana Forestry Department Planning Branch Entomology Report 2.

2874 Cores, E.C. 1889. **Teak caterpillar (*Hyblaea puera*)**. Indian Museum Notes, Calcutta 1: 52-53.

2875 Creffield, J.W; Thornton, J.D; Johnson, G.C; Nguyen, N.K. 1993. **An in-ground natural durability field test of Australian timbers and exotic reference species. IX. Termites and decay on hardwoods at the Walpeup site between 18 and 23 years after installation**. Materials und Organismen 28(3): 209-235.

Hardwood specimens including teak remaining at the Walpeup site in Australia were inspected for presence of termites and decay at yearly intervals. Termites numbers did not vary significantly. Soft rot was common whereas brown rot was rarely detected.

2876 Cubbit, G.E.C. 1901. **Life history of *Hyblaea puera***. Indian Forester 27(8): p422.

Reports on damage in Yemi Reserve, Pyinmana, Upper Burma, by *H. puera*. It is suggested that the insect pupates in any dense tree or shrubs or fallen leaves when undergrowth is absent. Tallest teak trees only are attacked while poles and saplings escaped and the injury is confined to upper branches.

2877 Dabral, S.L; Amin, P.W. 1975. **Poor fruit formation in teak in Chanda forests of Maharastra**. Indian Forester 101(10): 616-620.

Studies which showed that attack by larvae of *Pyrausta machaeralis* on flowers, calyces and newly set fruits of *Tectona grandis* was the cause of the trouble. Brief notes are given on the damage caused and on the life history, ecology and habitats of *P. machaeralis*; control measures are suggested.

2878 David, B.V; Sundararaj, R; Regu, K. 1991. **On four new species of *Odontaleyrodes* Takahashi (Aleyrodidae: Homoptera) with a key to Indian species**. Journal of Insect Science 4(2): 117-119.

A key to the Indian species of the genus *Odontaleyrodes* is provided. Out of four new species described O. splendens is collected from *Tectona grandis* in Kerala.

2879 Dawkins, C.G.E. 1921. **Notes on an attack of *Pyrausta machaeralis* on teak in Zogon and Tharrawaddy Division in 1920**. Indian Forester 47(5): 209-213.

Describes preliminary observations on the attack and observes that rain result in severe defoliation.

2880 Dhanarajan, G. 1976. **Some observations on the teak collar ring borer - *Endoclita gmelina* (Lepidoptera: Hepialidae) in north western Malaysia**. Malaysian Forester 39(4): 214-223.

Endoclita gmelina is a pest of some importance in experimental teak plantations in West Malaysia, and detailed information is given on its bionomics and the type of damage caused. The damage was usually confined to saplings and sometimes resulted in death. Preventive control measures suggested comprise the removal of Lantana and Eupatorium plants and the application of tanglefoot to the base of the young trees where attack normally begins.

2881 Dun, G.S. 1955. **Economic entomology in Papua and New Guinea, 1948-1954**. Papua New Guinea Agricultural Journal 9(3): 109-119.

Minor trials have been made in the protection of young seedlings which include the control of the teak moth, *Hyblaea puera*, with DDT and BHC.

2882 Edwards, J.P. 1953. **Other injurious insects**. Report of Forest Administration, Malaya 14.

Cossid moths were found attacking the boles and branches of young saplings and older tree of species including *Tectona grandis*.

2883 Eluwa, M.C. 1979. **Biology of *Lixus camerunu*s Kolbe (Coleoptera: Curculionidae): A major pest of the edible vernonias (compositae) in Nigeria**. Revue de Zoologie Africaine 93(1): 223-240.

L. camerunus is also known to attack the young foliage of economically valuable trees such as *Tectona grandis*.

2884 Eungwijarnpanya, S; Hedlin, A.F. 1984. **Studies on seed insects of some forest trees**. Embryon 1(1): 49-55. ASEAN Canada Forest Tree Centre, Saraburi, Thailand.

Preliminary observations are reported on damage caused by various insect species to seeds of eleven species including *Tectona grandis* of Thailand.

2885 Ferguson, J.H.A. 1949. ***Xyleborus destruens* in teak**. (Dutch). Tectona 39(4): 387-389 .

Summarized existing information on *X. destruens* damage to teak, and concludes that this borer occurs mainly in wet climates at high altitudes, where teak should not be planted.

2886 Fernandez, E.E. 1898. **A teak defoliator in the Central Provinces**. Indian Forester 24: p428.

2887 Fernandez, E.E. 1898. **Defoliation of teak in Central Provinces**. Indian Forester 24: p89.

2888 Fernando, S.N.U. 1965. **Insects commonly found in the teak nurseries of Ceylon**. Ceylon Forester 7(1/2): 54-56.

Notes on the seed borer, *Lasioderma serricorne*; skeletonizer, *Hapalia machaeralis*; root destroyer, *Oryctes rhinoceros*; defoliators, *Hyblaea puera* and *Aularches miliaris* and several aphids are given.

2889 Fletcher, T.B. 1914. **Some South Indian insects**. Government of India Press, Calcutta.

Gives accounts of insects damaging teak, mainly the red borer, *Zeuzera coffeae* and leaf skeletonizer, *Hyblaea puera*.

2890 Forest Department, Andhra Pradesh. 1965. **Annual report of the Soil Conservation Research Centre, Hyderabad**. Central Soil Conservation Research, Training and Demonstration Centre, Hyderabad, Annual Report 1964-65. Forest Department, Andhra Pradesh.

Gal formation was noticed in *Tectona grandis* caused by a Dipterous insect, *Itonididae cecidmemyildal*.

2891 Forest Department, Burma. 1932. **Tests in the Rangoon river on the damage by marine borers to various woods including Burma teak and British Guina Green-heart, cresoten and untreated**. Burma Forest Bulletin 28.

2892 Forest Department, Burma. 1936. **On the insect *Alcides ludificator***. Progress Report, Forest Administration, Burma 1935-36: p35.

2893 Forest Department, Burma. 1949. **Inderbela: Life history and alternate hosts**. Report of Working Plans Silviculture Entomology, Forest Department Burma 1940-41, 1948: 78-80.

This pest is an alternate host of *Nemeritis tectonae*, a parasite of bee-hole borer, hence considered important. Its polyphagous habits are likely to be of considerable assistance in establishing *Nemeritis tectonae*.

2894 Forest Department, Burma. 1949. **Pests of teak: *Xyleutes ceramica* Walk., the beehole borer**. Report of Working Plans Silvicultural Entomology, Forest Department, Burma 1940-41: 69-76 .

Life history and natural enemies.

2895 Forest Products Research Board, London. 1952. **Electro-chemical attack on boat-timbers**. Report of Forest Products Research Board, London 1952: 42-46.

Teak is one of the timbers studied.

2896 Gandhi, S.S; Pajni, H.R. 1988. **On two new species of genus *Indomecus* Pajni and Gandhi (Tanymecini, Brachyderinae, Curculionidae)**. Annals of Entomology 6(1): 7-12.

Indomecus bombayensis and *I. brevimandibularis* are described. *I. bombayensis* was collected from *Tectona grandis*. A key to species of the genus *Indomecus* is provided.

2897 Gardner, J.C.M. 1943 . **Entomological notes**. Indian Forester 69: 323-324.

Brief notes are included on termites in India and on a plan to maintain certain plants as undergrowth in teak forests in order to act as hosts to parasites of teak defoliators.

2898 Gardner, J.C.M. 1944. **A note on the imported lantana bug (*Teleonemia scrupulosa* Stal.)**. Indian Forester 70: 139-140.

Investigations on the Lantana bug were carried out at Dehra Dun in order to determine its reactions to the local climate, its effect on lantana and on other Verbenaceae such as teak. Once the lantana had been defoliated the bugs migrated to teak leaves, where they were able to feed and reproduce rather less rapidly.

2899 Gardner, J.C.M. 1944. **Young trees and *Phassus* borers (Lepidoptera: Hepialidae)**. Indian Forester 70(4).

2900 Garthwaite, P.F. 1940. **A guide to the borers of commercial timbers of Burma (cf. to *Xyleutes ceramica*)**.

2901 Ghaiglom, D. 1966. **Teak beehole borer and the control research in Thailand**. Vanasarn 24(3): 295-300.

Outlines the biology and ecology of *Xyleutes ceramica* and describes experiments on its control in N. Thailand. The most promising method, tested in 1965, is biological control by inoculation of the pest with the fungus *Beauveria bassiana* by injecting a mixture of dried spores and talc into the holes or dusting the mixture on to the stem surface.

2902 Ghaiglom, D. 1967. **Teak beehole borer-control research in Thailand**. Proceedings of the First Forestry Conference, Royal Forest Department, Ministry of Agriculture, Bangkok R.107: 414-415.

2903 Ghaiglom, D. 1990. **Outbreaks of forest insects and control operations in Thailand**. Proceedings of the IUFRO Workshop on Pests and Diseases of Forest Plantations in the Asia-Pacific Region, RFD Thailand F/FRED, FAO (RAPA), Bangkok: 219-223.

Chemical, biological and cultural control measures used against important insect pests of forest plantations including teak in Thailand are described. Biological control with a bacterial toxin of *Bacillus thuringiensis* Berliner was tested and proved to kill the larvae of both *H. puera*, and teak beehole borer, *X. ceramicus*.

2904 Ghorpade, B.R; Patil, S.P. 1991. **Insect pests recorded on forest trees in the Konkan region of Maharashtra State (India)**. Indian Journal of Forestry 14(3): 245-246.

The most important insect pests recorded on forest trees including teak are listed. *Eutectona grandis* was the most serious pest on teak.

2905 Ghude, D.B; Gogate, M.G. 1996. **Insect pests of teak in Maharashtra, India**. Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium, Peechi, 23-26 November 1993: 495-497. K.S.S. Nair; J.K. Sharma; R.V. Varma, Eds. Kerala Forest Research Institute, Peechi.

The major pests recorded from Maharashtra and the nature of damage caused by these are given. The pests are grouped into root and stem feeders, sap suckers, defoliators, tree borers, fruit borer and gall former.

2906 Gokulpure, R.S. 1969. **Record of tachinids from central India**. Indian Forester 95(3): 188-189.

Lists eight species, including *Hyblaea puera*, defoliator of teak.

2907 Gotoh, T. 1994. **Insect borers of some valuable timber species in Thailand**. Tropical Forestry 30: 30-37.

Descriptions include Xyleutes ceramicus and Dihammus cervinus damage to Tectona grandis.

2908 Gotoh, T; Kotulai, J.R; Matsumoto, K. 2004. **Stem borers of teak and yemane in Sabah, Malaysia with analysis of attacks by the teak beehole borer (*Xyleutes ceramica* Wlk)**. JARQ, Japan Agricultural Research Quarterly 37(4): 253-262.

2909 Gujar, D.R; Ghude, D.B; Gogate, M.G. 1996. **Incidence of a cerambycid girdler attack in teak seed orchard in Maharashtra, India**. Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium, Peechi, 23-26 November 1993: 498-501. K.S.S. Nair; J.K. Sharma; R.V. Varma, Eds. Kerala Forest Research Institute, Peechi.

Incidence of a cerambycid girdler attack on live teak trees in the teak seed orchard at Mohogata, District Bhandara of Maharashtra State is reported. Feeding by the grub resulted in girdling of the collar region. Severe infestations resulted in drying up and eventual death of the affected trees.

2910 Gupta, J.P. 1997 . **Histochemical investigations of leaf galls of *Tectona grandis* incited by an unknown midge from Sitamata forest-Rajasthan**. Journal of Phytological Research 10(1/2): 43-46.

Histochemical investigations were made on leaf galls of *Tectona grandis* caused by an unknown gall midge. The galls were discoid, covered with multicelled thick-walled acute trichomes and exhibited marked difference in the histology between gall and normal tissues.

2911 Harley, K.L.S. 1969. **The suitability of *Octotoma scabripennis* Guer. and *Uroplata girardi* Pic (Col., Chrysomelidae) for the control of Lantana (Verbenaceae) in Australia**. Bulletin of Entomological Research 58(4): 835-843.

Reviews the host range and biology of hispine beetles associated with lantana and related species, and reports studies of host specificity made in Hawaii with field populations of the introduced species *O. scabripennis* and *U. girardi*.

2912 Hauxwell, T.A. 1908. **A new species of beehole borer in teak**. Indian Forester 34(4): p216.

Identified as a species of *Aeolesthes*, a longicorn beetle and hence bee-holing and boring of teak is attributed to other *Duomitus ceramicus*.

2913 Hedegart, T. 1968. **Investigation on insects working in teak flowers-1967**. Report of Teak Improvement Centre, Ngao, Lampang: 6p.

A description of insects caught and amount of pollen they carried is given.

2914 Hole, R.S. 1901. **Attacks of *Hyblaea puera* on teak trees**. Indian Forester 27(7): 349-355; 417-422.

2915 Hole, R.S. 1904. **Notes on *Hyblaea puera***. Indian Forester 30(1): 1-10.

2916 Hole, R.S. 1904. **Two notorious insect pests: teak insect pests: *Pyrausta machaeralis* and *Hyblaea puera***. Journal of the Bombay Natural History Society 15: 679-697.

2917 Hutacharern, C. 1992. **Research development of teak insect pests in Thailand**. Proceedings of the Seminar on 50 Anniversary of Hyay-Tak Teak plantation, Bangkok, 5-8 August 1992.

Teak insects have been under studies in Thailand since 1958. Due to very large areas of teak plantations being damaged, studies on teak defoliators were initiated and this led to the establishment of the Northern Forest Pest Control Center. These researches have included pheromone, mass rearing, population dynamics and behaviours, with the principal purpose of developing effective control measures. Emphasis has been given to the further study of teak defoliators, especially with regard to natural enemies.

2918 Hutacharern, C. 2000. **Management of important insect pests in teak plantations in Thailand**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 223-238. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

Discussed the pest problems of the teak plantations in Thailand. The pests are divided into two groups: stem borers and defoliators. The most important stem borers are the teak beehole borer, the red coffee borer and the teak canker grub. Control methods of the stem borers and defoliators are also discussed.

2919 Hutacharern, C. 2001. **Teak beehole borer, *Xyleutes ceramica*: Ecology and management**. Protection of World Forests from Insect Pests: Advances in Research. IUFRO World Series 2: 249-253. R. Alfaro; K. Day; S. Salom; K.S.S. Nair; H. Evans; A. Liebhold; F. Lieutier; M. Wagner; K. Futai; K. Suzuki, Eds. IUFRO Secretariat, Vienna.

2920 Hutson, J.L. 1932. **The red borer**. Tropical Agriculturist, Ceylon 79(3): 137-138.

Gives an account and life history of the red borer *Zeuzera coffeae*.

2921 Intachat, J. 1998. **The identity of a Malaysian teak skeletonizer, *Paliga damastesalis* Walker (Lepidoptera: Pyralidae)**. Journal of Tropical Forest Science 10(4): 561-563.

Specimens of teak skeletonizers from Malaysia have been identified as *Paliga damastesalis*, while in native teak growing countries they have been known as *Eutectona machaeralis*. The essential differences between the two species are briefly described, and a list is given of Asian *Paliga* species and their synonyms.

2922 Intachat, J. 1999. **The life history of *Paliga damastesalis* Walker (Lepidoptera: Pyraloidea: Crambidae), a teak skeletoniser in Malaysia**. Journal of Tropical Forest Science 11(4): 663-671.

The life history of *Paliga damastesalis* was studied under laboratory and field conditions.

2923 Intachat, J. 2000. **Insect pests in teak and sentang: Are they a serious problem?** Conference on forestry and forest products research 1997: Proceedings of the Fourth Conference, Malaysia, 2-4 October 1997: 229-235. S. Appanah; S.Y.M. Yusoff; A.W. Jasery; K.K. Choon, Eds. Forest Research Institute Malaysia, Kuala Lumpur.

This paper highlights the major insect pests found, their modes of attack, the symptoms, and the severity of their attacks. The major pests of teak are *Paliga damastesalis*, *Hyblaea puera* and *Xyleutes ceramica*. The severity of the attacks depends on the age of the plants that are attacked and insect abundance. Possible chemical and biological control measures for these major insect pests are discussed.

2924 Intari, S.E. 1975. **An observation on bee-hole borer (*Duomitus ceramicus* Wlk.) on teak plantations at Kendal and Ciamis Forest Districts**. Laporan, Lembaga Penelitian Hutan 204: 14p.

Notes are given on the bionomics, injuriousness and world distribution of *Xyleutes ceramicus*, the larvae of which bore in trunks of teak.

2925 Intari, S.E. 1984. **Effect of *Neotermes tectonae* attack on the quality and quantity of teak timber**. (Indonesian). Laporan, Pusat Penelitian dan Pengembangan Hutan, Indonesia 444/447: 1-13.

Losses of quality construction timber are reported as a result of the infestation of teak stands in Java by *N. tectonae*.

2926 Intari, S.E. 1990. **Effects of *Neotermes tectonae* Damm attack on the quality and quantity of teak timber in the Kebonharjo Forest Division, Central Java**. (Indonesian). Buletin Penelitian Hutan 530: 25-35. Pusat Penelitian dan Pengembangan Hutan, Bogor.

Volume reduction in quality of the timber from construction to fuelwood grade was 249.48 and 231.30 m3.

2927 Jacob, J.P. 1989. **Impact of age correlated biochemical changes of host plant on food consumption and utilization efficiency of *Aularches scabiosae* F. (Orthoptera: Insecta)**. Proceedings of the Indian Academy of Sciences, Animal Sciences 98(6): 391-397.

The relative preference and maximum utilization of mature leaves compared to young and senescent leaves were attributed to changes in the chemical profile, particularly in the protein, nitrogen, carbohydrate, phenol and free fatty acid contents.

2928 Jacob, J.P; Balu, A; Murugesan, S; Deeparaj, B; Srinivasan, G. 2002. **Variation in defoliator incidence on teak clones**. Proceedings of Vistas of Entomological Research for the New Millennium, 2002: 164-172.

2929 Joseph, K.J. 1982. **The reflex froth-discharging behaviour in the coffee locust (*Aularches miliaris* L.) as an anti-predator defensive mechanism**. Entomon 7(4): 407-409.

During mass infestation by the acridid *Aularches miliaris* (L.) of more than 1000 acres of plantations of different species which include teak, reflex discharge of a foul-smelling frothy liquid from the mesothoracic spiracles was observed. The frothy masses grew into large bubble-shaped structures that finally enveloped the body of the insect. The role of this behaviour as a defence mechanism against predation is discussed .

2930 Kadambi, K. 1951. **Teak defoliation**. Indian Forester 77(1): 64-70.

Early flushing often permits a tree to escape defoliation because its leaves are too tough for the larvae by the time they start feeding. Early flushing is due to an abundant supply of ground moisture, which suggests the possibility that defoliation could be controlled in irrigated plantations by standardizing the method and frequency of irrigation.

2931 Kalshoven, L.G.E. 1919. **The red teak borer**. (Dutch). Meded Proefsta Boschw 4: 57-68. Forest Research Station.

2932 Kalshoven, L.G.E. 1920. **Preliminary investigations of the harmful effects on living teak of *Xyleborus destruens***. Tectona 13: 32-57.

2933 Kalshoven, L.G.E. 1922. **Notes on forest zoology for the Netherlands East Indies 4. Insects and the land of origin of *Tectona grandis* Linn.f.)**. Tectona 15: 786-793.

Historical, etymological and phytogeographical and zoogeographical facts lead to the controversy - Is teak a native tree to Java? Zoogeographical evidence with respect to *Hyblaea puera*, *Zeuzera coffeae*, *Xyleborus destruens*, *Calotermes tectonae* and *Duomitus ceramica* is discussed and pointing out absence or presence of typical teak pests in Java suggested detailed investigation on origin of teak in Java.

2934 Kalshoven, L.G.E. 1922. **Notes on forest zoology for the Netherlands East Indies 5. A curious injury of tops of teak saplings by Coccids and small boring caterpillar, *Dunctiferalis***. Tectona 15: 944-950.

Teak sapling borer is identified as *Zeuzera coffeae*. Infestation by Coccids and damaged by lepidopterous larvae which caused small burrows in the terminal buds and in the thick bases of the main rib of young leaves.

2935 Kalshoven, L.G.E. 1932. ***Dichocrocis punctiferalis*-Pyralidae-as a fruit borer of teak**. (Dutch; English). Tectona 25: 1613-1620.

Caterpillars found in teak fruits are identified as *Dichocrocis punctiferalis*. Both felty mesocarp and non-stony endocarp are eaten by caterpillars. Pupation takes place within fruits and life history described, with alternate food plants.

2936 Kalshoven, L.G.E. 1934. **The teak leaf skeletonizer, *Pyrausta machaeralis* in Java**. (Dutch; English). Tectona 27: 71-75.

Pyrausta machaeralia var. *rubicundalis* Walk. is an important defoliator and the author suggests the teak is not the natural food plant. This divergence in food habits in Java and India is attributed to biological races of the moth or differences in the two countries in teak varieties.

2937 Kalshoven, L.G.E. 1939. **A longicorn borer in living and dead teak trees: *Monohammus rusticator* Fab., Fam. Lamiidae**. (Dutch). Tectona 32: 321-337.

This borer is considered of minor importance to the cultivation of teak in Java. The insect suffers from a high mortality in the larval stage, due mainly to an infectious disease, and the infestation of living bark occurs only where rain is plentiful.

2938 Kalshoven, L.G.E. 1940. **Observations on the red-branch borer *Zeuzera coffeae***. (Dutch; English). Ent. Meded Netherlands, India 6(3/4): 50-54. Agricultural University, Wageningen.

2939 Kalshoven, L.G.E. 1951. **Important outbreaks of insect pests in the forests of Indonesia**. Trans. 9th International Congress of Entomology, Amsterdam, 1951, 2: 229-234.

Discusses defoliation of teak forests and other cultivated forest trees in Java.

2940 Kalshoven, L.G.E. 1954. **Survival of Neotermes colonies in infested teak trunks after girdling or felling of the trees**. Tectona 43: 59-74.

Observations were made on the development of colonies of *Neotermes* inhabiting trunks of teak trees after girdling and also when felled and left lying on the forest floor. A few colonies may survive for as long as 10 months and it may be assumed that they produce large numbers of winged sexuals.

2941 Kalshoven, L.G.E. 1959. **Investigations of the initial infestation of new teak plantations by the trunk-inhabiting termite, *Neotermes tectonae* Damm in Java**. Entomologische Berichten, Amsterdam 19(7): 138-142.

Infestation was found at age of five and the first mature colony at age seven. At twelve, 30 percentage of all trees were infested.

2942 Kalshoven, L.G.E. 1959. **Observations on the nests of initial colonies of *Neotermes tectonae* Damm. in teak trees**. Insectes Sociaux, Paris 6(3): 231-242.

An account of observations in Java showing that new colonies of *N. tectonae* are started in dead branches in the crown.

2943 Kalshoven, L.G.E. 1960. **Biological notes on the *Cryptotermes* species of Indonesia**. Acta Tropica, Basel 17(3): 263-272.

Includes biology, habits, distribution, control etc. of the drywood termites *Cryptotermes domesticus, Cryptotermes dudleyi* and *Cryptotermes cynocephalus*.

2944 Kalshoven, L.G.E. 1961. **Observations on the ecology and epidemiology of *Xyleborus destruens* Bldf., the near primary borer in teak plantations in Java**. Bijdragen tot de Dierkunde, Amsterdam 31: 5-21.

It is suggested that teak should not be planted in areas stimulating very rapid growth, as such trees become very susceptible.

2945 Kalshoven, L.G.E. 1962. **Note on the habits of *Xyleborus destruens* Bldf., the near primary borer of teak trees in Java**. Entomologische Berichten, Amsterdam 22(1): 7-18.

Discussed outward signs of the borers' presence, their galleries, development and general biology, sex ratio, nutrition etc.

2946 Kalshoven, L.G.E. 1962. **Observations on *Coptotermes havilandi* Holmgr. (javanicus Kemn.) (Isoptera)**. Beaufortia, Amsterdam 9(101): 121-137.

Describes habits, nests, etc. mainly from observations in Javanese teak forests and gives a list of tree species attacked. Infested teak has been found.

2947 Kalshoven, L.G.E. 1963 . ***Coptotermes curvignathus* causing the death of trees in Indonesia and Malaya**. Entomologische Berichten, Amsterdam 23: 90-100.

Discusses its habitats and habits and the tree species attacked. Species including teak, appear to be susceptible.

2948 Katagal, R.D. 1996. **Incidence of defoliators in the teak plantation**. Insect Environment 2(1): p20.

A brief account is given of observations on the skeletonizer *Eutectona machaeralis* and the defoliator *Hyblaea puera* in a private teak plantation in Mahalingapur village, Bijapur district, Karnataka. Biological control possibilities are discussed.

2949 Katagal, R.D; Kumar, C.T.A; Kurdikeri, M.B. 2000. **Insect pests of teak around Bangalore**.

Karnataka Journal of Agricultural Sciences 13(1): 176-179.

A survey of insect pests attacking teak plantation was carried out in Karnataka. A total of 45 species were recorded from the teak plantations. Details are given of the five peak infestations and the insects involved.

2950 Katagal, R.D; Kumar, C.T.A; Kurdikeri, M.B. 2000. **Record of defoliator fauna in teak plantation**. Karnataka Journal of Agricultural Sciences 13(1): 180-183.

The intensity of infestation was recorded. Eighteen species of defoliators including a skeletoniser and leaf miner were recorded. The intensity of infestation was highest with *Myllocerus subfasciatus* var. *mutabilis* and *M. subfasciatus* var. spurcatus.

2951 Kedharnath, S; Singh, P. 1975. **Studies on natural variability in susceptibility of Tectona to leaf skeletonizer, *Pyrausta machaeralis***. Proceedings of the FAO/IUFRO Symposium on Forest Diseases and Insects, New Delhi.

2952 Kerala Forest Research Institute, Peechi. **The teak defoliation (Video film)**. (English; Malayalam). Kerala Forest Research Institute, Peechi.

A 20 minute scientific documentary on the teak defoliator, *Hyblaea puera*, the most dangerous forest plantation pest of the Asian tropics. Depicts the biology, pest population outbreaks and defoliation of the pest. Summarises the present knowledge on outbreak causation and suggests management methods.

2953 Khan, H.R; Bhandari, R.S; Lalji Prasad; Sushil Kumar. 1988. **Population dynamics of *Hyblaea puera* Cram. (Lepidoptera: Hyblaeidae) and *Eutectona machaeralis* Walk. (Lepidoptera: Pyralidae) in teak forest of Madhya Pradesh (India)**. Indian Forester 114(11): 803-813.

The seasonal abundance and population dynamics associated with incidence of attack were studied. The results are discussed in relation to pest status.

2954 Kietchaiyakorn, W. 1973. **Studies on the ecology of the bee-hole borer of teak (*Xyleutes caramicus* Walker)**. Special Problem of Study of Biology Department (Science), University of Thailand, Chaing-Mai 1973: 26p. Teak Improvement Centre, Ngao.

The biology of teak bee-hole borer *Xyleutes caramicus* walker was described. Older plantations are more susceptible. *Beauveria bassiana*, fungus used for biological control causes more mortality to the borer.

2955 Kossou, D.K. 1992. **The sensitivity of wood used for the construction of traditional granaries to attack by *Prostephanus truncatus* (Horn) (Coleoptera: Bostrichidae)**. Insect Science and its Application 13(3): 435-439.

Timber from 10 wood species widely used to construct granaries or cribs in Benin was tested for its susceptibility to *Prostephanus truncatus*. Timbers including *Tectona grandis* were the more susceptible species.

2956 Kumar, C.T.A; Katagal, R.D; Onkarappa, S. 2002. **Host preference of the teak defoliator, *Hyblaea puera* (Cramer) among the forest trees**. Myforest 38(3): 295-298.

A study was conducted to determine the effect of different host plants on the life cycle of the teak defoliator *Hyblaea puera*. The larva completed its development within 12 days on teak and the pupal period was found shortest in the larva reared on teak.

2957 Kyaw Sein, U. 1963. **The bee-hole borer of teak (*Xyleutes ceramica* Wlk.)**. Burmese Forester 13(2): 32-39.

A general account is given.

2958 Lakanavichian, S; Napompeth, B. 1990. **Ecological study of teak defoliators, *Hyblaea puera* and *Eutectona machaeralis* in Thailand**. Proceedings of the IUFRO Workshop on Pests and Diseases of Forest Plantations in the Asia-Pacific Region, RFD Thailand, F/FRED, FAO (RAPA), Bangkok: 155-166.

Altogether thirteen species of parasitic insects and three species of predators were found attacking these defoliators. Ecological studies on the teak defoliators, *Hyblaea puera* and *Eutectona machaeralis* were made under laboratory and field conditions.

2959 Lara, L.L. 1980. **Some common insect pests among the insect fauna of forests in Colombia. Aspects of their biology and control**. Sociedad Colombiana de Entomologia: Seminar on Forest Pests, Pereira, 27 November 1980: 117-132. Sociedad Colombiana de Entomologia; Bogota; Colombia.

Notes are given on the life-cycle and injuriousness and control of insect pests that attack forest trees in Colombia. Forest pests that included bagworms, *Oiketicus* sp. that attack teak.

2960 Lefroy, H.M. 1909. **A manual of the insects of plants (tropical India) 1. Lepidoptera**. Agricultural Research Institute, Pusa, New Delhi: 520p. Government of India Press, Calcutta.

Gives notes on the leaf skeletonising insects, *Hapalia machaeralis*, *Hyblaea puera* and *Cosus cadambae*.

2961 Lingappa, S; Hiremath, I.G; Deshpande, V.P. 1991. **A new threat to forest gold**. Myforest 27(1): 55-56.

Extensive occurrence of the teak stem borer, *Cossus cadambae* causing damage to stands in Karnataka is reported from a preliminary survey. Observations are presented on the biology of the pest and damage caused by it.

2962 Loganathan, J; David, P.M.M. 1999. **Rain fall: A major factor leading to outbreak of teak (*Tectona grandis*) defoliator, *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidae) in commercial teak plantation**. Indian Forester 125(3): 316-320.

Statistical analysis showed a significant positive relationship between defoliator incidence and rainfall, which therefore appeared to be the probable cause of the defoliator outbreak - delay in the rainfall lead to delay in defoliator infestation and vice-versa.

2963 Loganathan, J; David, P.M.M. 2000. **Impact of flood irrigation on defoliator attack in commercial teak plantation**. Madras Agricultural Journal 87(4/6): 328-329.

The effects of two irrigation systems, i.e. flood and drip irrigation, on the severity of defoliator attack was investigated. The severity of defoliator attack was high under both irrigation systems.

2964 Loganathan, J; Soman, P; Maragatham, S. 2001. **Monitoring of two major pests of teak in intensively managed plantation through light trap study**. Indian Forester 127(9): 1047-1052.

The population dynamics of teak defoliator and teak skeletonizer were studied in intensively managed teak plantation in Andhra Pradesh by installing light traps. A significant positive influence of rainfall and negative influence of wind velocity on defoliator is reported.

2965 Lopez-Castilla, R.A; Duarte-Casanova, A; Guerra-Rivero, C; Cruz-Escoto, H; Triguero-Issasi, N. 2002. **Forest nursery pest management in Cuba**. Western Forest and Conservation Nursery Association Conference, Kailua-Kona, Hawaii, 22-25 August 2000. Proceedings of Rocky Mountain Research Station, USDA Forest Service, 2002: 213-218. Rocky Mountain Research Station, Fort Collins.

A dozen insect species and three fungi species responsible for the major problems in forest nurseries in Cuba are studied. A defoliator of teak, *Draeculocephala cubana* is also reported.

2966 Mackenzie, J.M.D. 1941. **Some notes on forest insect pests in Burma**. Indian Forester 47(8): 309-317.

Attributes defoliation in teak to *Hyblaea puera* and *Pyrausta machaeralis* and comments on net increments loss, volume loss and financial loss in teak plantations of Burma due to insect attacks and defoliation. The damage caused by beehole borer *Duomitus ceramicus* is also discussed and remarks on life history and biological control of these insect pests is given.

2967 Mahobia, G.P; Pande, V.K; Sinha, B.R.R.P. 2002. **Frequency occurrence of Raily ecorace of *Antheraea mylitta* D. on different food plants in Bastar forest division in Chhattisgarh, India**. Bulletin of Indian Academy of Sericulture 6(2): 56-60.

The frequency of occurrence of natural cocoons of Raily ecorace of *A. mylitta* on different food plants including *Tectona grandis* in the forests of Bastar is studied.

2968 Mani, M.S. 1953. **On a collection of plant galls and gall midges from India**. Agra University, Journal of Research 2 (Part 2): p247.

Gives description of plant galls and gall midges of some Indian plants including teak.

2969 Mathew, G. 1986. **The teak carpenterworm, *Cossus cadambae* and its status as a pest in plantations**. Evergreen 17: 29-31.

An attempt is made to highlight the economic importance of a carpenterworm pest of teak in southern India viz., *Cossus cadambae*. Dealt with its life cycle, distribution, host range, seasonality and natural enemies.

2970 Mathew, G. 1987. ***Cossid* pests of plantation crops in India and the prospects of their management**. Proceedings of the Workshop on Insect Pest Management Strategies in Coffee, Tea and Cardamom Cropping Systems, Chikmangalore: 137-140.

The behaviour patterns and pest management of cossids in plantation crops in India were reviewed. Discussed various control measures which include the removal of infested trees for the control of *X. ceramica* in teak plantations and the use of pheromones for mass trapping.

2971 Mathew, G. 1990. **Biology and ecology of the teak trunk borer *Cossus cadambae* Moore and its possible control**. KFRI Research Report 68: 41p. Kerala Forest Research Institute, Trichur.

Studies were made on the biology, ecology and possible control of the teak trunk borer *Cossus cadambae*. The distribution of this insect in the various teak plantations in Kerala was studied. Plantations found affected were above 20 years old and the infestation intensity was found to increase with age. The progression of attack in plantations of varying levels of infestation intensity was studied.

2972 Mathew, G. 1990. **Cossid pests of teak in Asian region and the possibilities of their control**. Proceedings of the IUFRO Workshop on Pests and Diseases of Forest Plantations in the Asia-Pacific Region, RFD Thailand, F/Fred, FAO (RAPA), Bangkok: 204-208.

A combination of management strategies integrating silvicultural, pheromonal as well as biological control measures is required for controlling the infestation of cossid pests in teak plantations. Four species of carpenter worms viz. *Zeuzera coffeae*, *Z. roricyanea*, *Syleutes ceramicus* and *Cossus cadambae* attack teak in the Asian region; a review is made of their distribution, habits, biology and control.

2973 Mathew, G. 1991. **Biology, seasonal population trends and impact of the teak carpenterworm *Alcterogystia cadambae* (Moore) (Lepidoptera: Cossidae)**. Annals of Entomology 9(2): 39-46.

The biology and injuriousness of *Alcterogystia cadambae*, a pest of teak were investigated in the laboratory and field in Kerala. Larval feeding on the bark led to callus formation and secondary infection by microorganisms resulting in die-back of infested trees. Borer holes in affected timber caused depreciation in the commercial value of extracted wood.

2974 Mathew, G. 1997. **Distribution, infestation progression rate and host range of the teak carpenterworm, *Alcterogystia cadambae* Moore (Lepidoptera: Cossidae) in Kerala, India**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 86-92. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Studies on the distribution, host range, and progression of infestation of the teak borer, *Alcterogystia cadambae* Moore were made. Mechanical injury to trees such as lopping of branches, extraction of leaves, etc. promote establishment of this pest. Protection of trees from mechanical injury is suggested for regulating the build up of the pest in teak plantations.

2975 Mathew, G; Mohandas, K. 1989. **Insects associated with some forest trees in two types of natural forests in the Western Ghats, Kerala (India)**. Entomon 14(3/4): 325-333.

Insects occurring in moist deciduous and evergreen forests were surveyed in Kerala. Defoliation of species which include *Tectona grandis*.

2976 Mathew, G; Rugmini, P. 1996. **Impact of the borer *Alcterogystia cadambae* (Moore) (Lepidoptera: Cossidae) in forest plantations of teak in Kerala, India**. Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium, Peechi, 23-26 November 1993: 304-310. K.S.S. Nair; K.J. Sharma; R.V. Varma, Eds. Kerala Forest Research Institute, Peechi.

It causes extensive bark injury and riddling of the bole with numerous holes. The infested tree subsequently gets attacked by various pathogenic/saprophytic fungi which results in die-back as well as decay of wood.

2977 Mathew, G; Rugmini, P; Jayaraman, K. 1989. **Studies on spatial distribution in the teak carpenterworm, *Cossus cadambae* Moore (Lepidoptera, Cossidae)**. Journal of Research on the Lepidoptera 28(1/2): 88-96.

A considerable number of trees in a plantation were affected during the initial stages of infestation. In the subsequent phase, already infested trees tended to be reinfested, while healthy trees were also attacked.

2978 Mathew, G; Sudheendrakumar, V.V; Mohanadas, K; Nair, K.S.S. 1990. **An artificial**

diet for the teak defoliator, *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidea). Entomon 15(3/4): 159-163.

Synthetic diets containing teak leaf powder and *Cicer arietinum* flour were developed for rearing *Hyblaea puera*. The growth and development of 3- to 4-day-old larvae was compared on these diets and on teak leaves in the laboratory. Pupal weight and percentage survival were greater on the diet than on teak leaves.

2979 Mathur, R.N. 1956. **Immature stages of Indian Coleoptera (28): Anthribidae**. Indian Forest Records (n.s.) Entomology 9(5): 127-129.

The larval and pupal characters of *Autotropis modesta* are described with illustrations. It was found infesting a partly dead teak stump in the Andamans.

2980 Mathur, R.N. 1960. **Important problems in forest entomology of India**. Proceedings of 11th International Congress of Entomology, Vienna Vol. 2: 277-283.

Recent research on defoliators of teak is also reviewed with other problems of forest insects.

2981 Mathur, R.N. 1960. **Pests of teak and their control**. Indian Forest Records (n.s.) Entomology 10(3): 43-66.

Describes insect pests of living trees, felled trees and timber and classified according to the type of damage. The most important are *Hapalia machaeralis*, *Hyblaea puera*, *Dihammus cervinus, Sahyadrassus malabaricus* and *Xyleutes ceramica*. Control measures are discussed.

2982 Mathur, R.N. 1960. **Pests of teak and their control**. FAO Teak Sub-Commission, New Delhi, 1960, FAO/TSC-60/3.6: 25p.

Lists the pests by type of injury, with notes on life history, parasites and predators, etc.

2983 Mathur, R.N. 1964. **Forest entomological problems in India**. FAO/IUFRO Symposium on Internationally Dangerous Forest Diseases and Insects, Oxford.

Deals with teak defoliation caused by *Hapalia machaeralis* and *Hyblaea puera*.

2984 Mathur, R.N; Singh, B. 1960. **A list of insect pests of forest plants in India and the adjacent countries**. Indian Forest Bulletin (n.s.) 171(9), Entomology Series: 10-20.

Tectona grandis is one of the many species for which the insect pests have been listed.

2985 Mehrotra, M.D; Sharma, V. 1990. **Occurrence of root knot nematodes in forest nurseries**. Indian Forester 116(10): p846.

A preliminary report is given of the occurrence of root knot nematodes in forest nurseries in India including *Tectona grandis*.

2986 Mein, A.J. 1879. **Notes on the occurrence of teak borer beetle in Assam**. Indian Forester 4(9): 346-349.

2987 Mein, A.J. 1883. **Attacks of insects in the Kulsi teak plantations, Kamarup, Assam**. Indian Forester 9: p366.

Reports on swarms of *Hyblaea puera* eating and denuding leaves of older trees, and pupating in long grass below, but no damage to trees.

2988 Menon, K.D. 1952. **Cossid moth attack on young plantation trees**. Malaysian Forester 15(4): 208-209.

This moth has been attacking plantations at Kepong, attacking young trees of species including *Tectona grandis*.

2989 Menon, K.D. 1963. **Defoliation of teak in north-west Malaya**. Malaysian Forester 26(3): 209-210.

A note on the defoliation of a plantation in Perlis by an outbreak of yellow butterflies.

2990 Meshram, P.B; Pathak, S.C; Jamaluddin. 1990. **Population dynamics and seasonal abundance of some forest insect pests (nursery stage) through light trap**. Indian Forester 116(6): 494-503.

Trapped insects include the teak defoliator, *Hyblaea puera*; the teak skeletonizer, *Eutectona machaeralis*; the white root grub, *Holotrichia serrata*.

2991 Meshram, P.B; Patra, A.K. 2003. **Heavy outbreak of parakeet *Psittacula krameri* (Scopoli) in Hi-Tech teak plantations at Chhindwara**. Indian Forester 129(3): 413-414.

A severe infestation of *Psittacula krameri* in teak plantations in Chhindwara, Madhya Pradesh is reported for the first time. Control measures are suggested.

2992 Mieke, S. 1994. **Some pests and diseases of forest timber estate in Indonesia**. JIRCAS

International Symposium Series, Japan, March 1994, No. 1: 158-162.

A list of the forest pests and diseases attacking fruits/seeds, leaves, stems and the root system is presented in this report.

2993 Mishra, G.P; Joseph, R.N. 1982. **Defoliation in teak by lepidopterous defoliators in a mixed dry deciduous forest of Sagar, Madhya Pradesh**. Indian Forester 108(8): 372-373.

Data are tabulated on defoliation on plateau, slope and base areas.

2994 Mishra, S.C. 1992. **Digestion of major food (leaf) components by the teak defoliating lepidopterous larvae *Hyblaea puera* Cram. (Hyblaeidae) and *Eutectona machaeralis* Walk. (Pyralidae)**. Indian Forester 118(11): 848-855.

Hyblaea puera and *Eutectona machaeralis* are both serious pests of teak in India, particularly when they occur together. The larvae of *E. machaeralis* feed on the older leaf tissues between the veins while those of *H. puera* feed on the tender leaves. Leaf contents and digestion of each chemical component are discussed and the probable mechanism of degradation of polysaccharides and lignins indicated.

2995 Mishra, S.C; Sen Sarma, P.K. 1986. **Host specificity test and a note on life history of *Leptobyrsa decora* Drake (Hemiptera: Tingidae) on teak**. Bulletin of Entomology, New Delhi 27(2): 81-86.

Studies on the host-specificity of the tingid *Leptobyrsa decora* and observations on its life history on the weed *Lantana camara* and on *Tectona grandis* were carried out in an insectary. The adults were able to survive on *T. grandis*, but could not survive for longer periods on *T. grandis* than they did on *L. camara* due to the thickness of teak leaves. The life history of the insect and its potential for the control of the weed are discussed.

2996 Misra, M.P. 1975. **Sexing of pupae and adult moths of teak skeletonizer, *Pyrausta machaeralis* Walker (Lepidoptera: Pyralidae)**. Indian Forester 101(5): 301-304.

The secondary sexual characters of pupae and adults of *Pyrausta machaeralis*, a pest of teak in India are described.

2997 Mohammad Yousuf; Joshi, K.C. 2003. **Description of a new species of *Oligosita* Haliday (Hymenoptera: Trichogrammatidae) from India**. Shashpa 10(1): 7-8.

2998 Mohanadas, K. 1986. **A new host record for the teak defoliator, *Hyblaea puera* (Lepidoptera: Hyblaeidae)**. Current Science 55(23): 1207-1208.

Vitex altissima was recorded for the first time as a host plant of *Hyblaea puera*, a pest of teak in Kerala.

2999 Mohanadas, K. 1997. **Population trend of *Hyblaea puera* Cramer (Lepidoptera, Hyblaeidae) in teak plantations and the factors influencing it**. Ph.D Thesis. Cochin University of Science and Technology, Kerala.

3000 Mohanadas, K; Mathew, G; Gopinath, A. 2000. **Incidence of the cotton aphid, *Aphis gossypii* Glover (Homoptera: Aphididae) on teak inflorescence in Kerala**. Annals of Forestry 8(2): 289-290.

3001 Mohanasundaram, M. 1981. **Five new species of *Anthocoptes* Nalepa (1892) (Eriophyidae: Acarina) from South India**. Entomon 6(4): 343-350.

Five new species of eriophyid mite of the genus *Anthocoptes* from southern India are described of which *A. tectonae* collected from teak.

3002 Mohanasundaram, M. 1981. **Record of Rhyncaphytoptid gall mites (Rhyncaphytoptidae: Eriophyoidea) from south India**. Oriental Insects 15(1): 45-55.

Notes are given on eight species of rhyncaphytoptid mites collected in southern India, of which *Diptilomiopus jevremovici* Keifer was collected from various plants and trees including teak.

3003 Murali, K.S; Sukumar, R. 1993. **Leaf flushing phenology and herbivory in a tropical dry deciduous forest, southern India**. Oecologia 94(1): 114-119.

Patterns of leaf flushing phenology of trees in relation to insect herbivore damage were studied at a tropical dry deciduous forest site and a tropical dry thorn forest site in Mudumalai, Tamil Nadu. The most common tree species at the deciduous forest site include teak. The observations indicate that herbivory may have a significant role in evolution of leaf flushing phenology in trees from the seasonal tropics.

3004 Murugan, K; Kumar, N.S. 1996. **Host plant biochemical diversity, feeding, growth and reproduction of teak defoliator *Hyblaea pu-***

era **(Cramer) (Lepidoptera: Hyblaeidae)**. Indian Journal of Forestry 19(3): 253-257.

Food consumption, utilization and reproduction of the teak defoliator, *Hyblaea puera*, showed age specific preferences amongst young, mature and senescent host leaves in laboratory experiments. The amount of leaves consumed, total egg output and adult longevity were maximum in *H. puera* reared on young leaves.

3005 Nair, K.S.S. 1982. **Seasonal incidence, host range and control of the teak sapling borer, *Sahyadrassus malabaricus***. KFRI Research Report 16: 36p. Kerala Forest Research Institute, Peechi.

The incidence of infestation of *S. malabaricus* in plantations of teak, eucalypts and other species is described and given an account of its life history, ecology and control methods. The most important forest trees attacked include saplings of teak.

3006 Nair, K.S.S. 1987. **Migration, a mechanism of parasite evasion**. Advances in Biological Control Research in India. Proceedings of the National Seminar on Entomology, Calicut, Kerala: 84-86.

Migration is a strategy used by some insects to escape parasitism. The teak defoliator, *Hyblaea puera*, in which, moths newly emerging from an epidemic area migrate to another area for egg laying, leaving behind the parasitoid population built up during their generation.

3007 Nair, K.S.S. 1987. **Life history, ecology and pest status of the sapling borer, *Sahyadrassus malabaricus* (Lepidoptera, Hepialidae)**. Entomon 12(2): 167-173.

The biology of *Sahyadrassus malabaricus* on teak and *Trema orientalis* was studied in the field in Kerala.

3008 Nair, K.S.S. 1988. **The teak defoliator in Kerala, India**. Population Dynamics of Forest Insects: 267-289. A.A. Berryman, Ed. Plenum Press, New York.

Two species of insects are well-known pests of the teak tree in India - *Hyblaea puera* and *Eutectona machaeralis*. One of the most promising approaches to its management appears to be the attempt to break the synchrony between flushing of teak and spring arrival of moths, by breeding early flushing varieties of teak.

3009 Nair, K.S.S. 1991. **Social, economic and policy aspects of integrated pest management of forest defoliators in India**. Proceedings of a Symposium, Towards integrated pest management of forest defoliators, 18th International Congress of Entomology, Vancouver, Canada, 1988. Forest Ecology and Management 39(1/4): 283-288.

Factors which have hindered successful development and adoption of integrated pest management strategies against forest defoliators are summarized.

3010 Nair, K.S.S. 2000. **Insect pests and diseases in Indonesian forests: An assessment of the major threats, research efforts and literature: 91p**. Center for International Forestry Research, Jakarta, Indonesia.

Major pests and diseases of natural and planted Indonesian forests have been reviewed, threats assessed and a bibliography compiled. Major plantation species include *Tectona grandis*.

3011 Nair, K.S.S. 2003. **Pest factor in the intensification of teak cultivation - a global assessment**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Pest problems arising from intensive plantation management are not judged to be serious, but expansion of exotic plantations could lead to serious outbreaks of the defoliator, *Hyblaea puera*, which is a well-known pest of native teak plantations in Asia. Research is needed to elucidate the conditions which lead to development of outbreaks of this serious pest.

3012 Nair, K.S.S; Mathew, G; Mohanadas, K; Menon, A.R.R. 1986. **A study of insect pest incidence in natural forests**. KFRI Research Report 44: 28p. Kerala Forest Research Institute, Peechi.

Insect damage was studied in representative natural forests in Kerala. Observations were made on twenty tree species in moist deciduous forest and eighteen in evergreen forest. A total of 85 insects was found on the 20 species studied in the moist deciduous forest. A total of eight insects was found on the 18 species studied in the evergreen forest. These insects are listed, with notes of the host, damage noticed, and previous records of insects on that host.

3013 Nair, K.S.S; Mohanadas, K; Sudheendrakumar, V.V. 1994. **Development of a management strategy for the teak defoliator, *Hyblaea puera***. KFRI Research Report 95: 125p. Kerala Forest Research Institute, Peechi.

The population dynamics of *Hyblaea puera* was investigated over a three year period by sampling immature stages of the pest. The noticeable event in the widespread outbreak of the caterpillar was the sudden occurrence of high density infestation at tree tops. Evidences indicate that *H. puera* population outbreak is of the eruptive types. The practical implications of the results for management of the teak defoliator and the future efforts needed are discussed briefly.

3014 Nair, K.S.S; Mohanadas, K. 1996. **Early events in the outbreak of the teak caterpillar, *Hyblaea puera***. International Journal of Ecology and Environmental Sciences 22: 271-279.

The first noticeable event in the chain of events leading to widespread outbreak of *Hyblaea puera* is the sudden occurrence of fairly high density, tree top infestations in small, discrete patches. The evidence indicate that *H. puera* population outbreak is of the eruptive type.

3015 Nair, K.S.S; Sudheendrakumar, V.V; Varma, R.V; Chacko, K.C. 1985. **Studies on the seasonal incidence of defoliators and the effect of defoliation on volume increment of teak**. KFRI Research Report 30: 78p. Kerala Forest Research Institute, Peechi.

The seasonal incidence of defoliation and its effect on the growth of teak were studied in plantations in Kerala. A model of the population dynamics of *H. puera* is proposed. The most serious impact of defoliation was loss of volume increment.

3016 Nair, K.S.S; Sudheendrakumar, V.V. 1986. **Population dynamics of teak defoliators**. Proceedings of the 18th IUFRO World Congress Division 2, Ljubljana, Yugoslavia, 8-12 September 1986. Vol.2; 673-684.

The biology and seasonal population fluctuations of the principal defoliators of teak in tropical India are examined. The mechanisms by which epidemics of *H. puera* may profoundly influence the population dynamics of *Eutectona machaeralis* is described and the importance of interactions among the pests stressed.

3017 Nair, K.S.S; Sudheendrakumar, V.V. 1986. **The teak defoliator, *Hyblaea puera*: Defoliation dynamics and evidences for short-range migration of moths**. Proceedings of the Indian Academy of Sciences, Animal Science 95(1): 7-21.

In teak plantations at Nilambur, Kerala, *Hyblaea puera* caused one or two waves of epidemic defoliation between late April and July. The temporal and spatial distribution of infestation and certain behavioural characteristics of population gave evidence of short-range migration of newly emerged moths. In a model proposed for population dynamics of *H. puera*, no diapause occurs and a residual, non-migratory population exists in natural forests during the non-epidemic period.

3018 Nair, K.S.S; Sudheendrakumar, V.V; Varma, R.V; Chacko, K.C; Jayaraman, K. 1996. **Effect of defoliation by *Hyblaea puera* and *Eutectona machaeralis* (Lepidoptera) on volume increment of teak**. Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium, Peechi, 23-26 November 1993: 257-273. K.S.S. Nair; J.K. Sharma; R.V. Varma, Eds. Kerala Forest Research Institute, Peechi.

The impact of defoliation on plantation grown teak was studied at Nilambur in Kerala. *E. machaeralis* which feeds on older leaves towards the end of the growth season had no significant impact on tree growth. *H. puera* which caused 1 to 3 total or near-total defoliations per year during the early part of the growth season caused very significant loss of increment. It is suggested that in theory, protected plantations can yield the same volume of wood in 26 years as unprotected plantations would yield in 60 years, provided other necessary inputs are given.

3019 Nair, K.S.S; Sudheendrakumar, V.V; Varma, R.V; Mohanadas, K. 1998. **Tracing the epicentres of teak defoliator outbreaks in Kerala**. KFRI Research Report 147: 27p. Kerala Forest Research Institute, Peechi.

It appears that many of the large-scale outbreaks can be prevented by controlling the small epicentre populations. An experimental study involving control of epicentre populations is recommended to examine the effectiveness of this approach to teak defoliator management. The study also revealed that teak plantations in all areas are not equally prone to defoliator attack - incidence of outbreaks appears to be strongly correlated with the mountain features of the planted area.

3020 Nair, K.S.S; Varma, R.V; Mathew, G; Sudheendrakumar, V.V; Mohanadas, K. 1996. **Perceived impact of insect pest problems in forest plantations in Kerala**. Impact of Diseases and Insect Pests in Tropical Forests. Proceedings of the IUFRO Symposium, Peechi, 23-26 November 1993: 317-323. K.S.S. Nair, et al, Eds. Kerala Forest Research Institute, Peechi and FORSPA, Bangkok.

An assessment of the insect pest problems in forest plantations in Kerala is made. This gives a reflection of the importance of pest problems are perceived by the resource managers. The perceived impact is then compared with the real impact as judged from the available scientific data. The study showed that the perceived impact matched with the real impact only in some cases.

3021 Nakamura, K; Nakashima, T; Ikeda, T; Eungwijarnpanya, S; Yincharoen, S; Hutacharern, C. 2002 . **Sex pheromone of the teak beehole borer, *Xyleutes ceramicus***. Proceedings of the IUFRO FAO Workshop on Pest Management in Tropical Forest Plantations, Chanthaburi, Thailand, 25-29 May 1998. C. Hutacharen; B. Napompeth; G. Allard; F.R. Wylie, Eds. FORSPA-Publication 30: 93-98. FAO Regional Office for Asia and the Pacific, Bangkok.

To identify the sex pheromone of *Xyleutes ceramicus*, conducted extraction from female moths, separation of crude extracts into fractions on Sep-pak silica cartridge, $AgNO_3$-silica gel column chromatography and gas chromatography. Obtained active fraction eliciting strong male responses for further analyses of chemical structure of sex pheromone which are suggested to be acetate group.

3022 Nansen, C; Meikle, W.G. 2003. **Use of pheromone-baited trap catches as indicators of occurrence of potential hosts of *Prostephanus truncatus* (Horn) (Coleoptera: Bostrichidae) in a forest in southern Benin**. Advances in stored product protection. Proceedings of the 8th International Working Conference on Stored Product Protection, York, UK, 22-26 July 2002. P.F. Credland; D.M. Armitage; C.H. Bell; P.M. Cogan; E. Highley, Eds: 71-77. CABI Publishing, Wallingford, UK.

The traps were established inside the forest, in a teak plantation surrounding the forest and at four sites approximately 50 m from smallholders' maize stores. Pheromone trap catches were highest in teak-dominated vegetation. In subsequent rearing experiments in the laboratory, the reproductive rate of *P. truncatus* on teak branches, roots and seeds was studied.

3023 Natawiria, D; Tarumingkeng, R.C. 1971. **Some important pests of forest trees in Indonesia**. Rimba Indonesia 16(3/4): 151-165.

Reviews the biology, economic importance and control of *Neotermes tectonae*, the borer *Xyleborus destruens*and the teak leaf skeletonizer *Pyrausta machaeralis* all on *Tectona grandis* and the borer *Xystrocera festiva*. Severe outbreaks of *P. machaeralis* have been reported in the main teak-growing areas of Java. Some parasites and predators are listed.

3024 Nayak, B.G; Hanumantha, M; Ganigera, B.S; Patil, S.K. 2002. **Infestation status of teak leaf skeletonizer, *Eutectona machaeralis* Walk. (Lepidoptera: Pyralidae) in different locations of Uttara Kannada District**. Myforest 38(4): 373-377.

A survey was conducted in selected teak plantations in Karnataka. Results showed that leaf skeletonizer infestation was more severe and causes more damages in plantations in Sirsi taluk and Honnavar taluk plantations compared to remaining taluks.

3025 Patil, B.V; Thontadarya, T.S. 1981. **Record of *Beauveria bassiana* (Balsamo) Vuillemin on teak skeletonizer, *Pyrausta machaeralis* (Walker)**. Indian Forester 107(11): 698-699.

Eutectona machaeralis skeletonises the leaves of teak. Of 180 larvae collected in teak plantations in Karnataka, 52 were found to be infected with *Beauveria bassiana*. Healthy 3rd-, 4th- or 5th-instar larvae artificially infected with this fungus in the laboratory died within 2 days.

3026 Patil, B.V; Thontadarya, T.S. 1983. **Seasonal incidence of teak skeletonizer *Pyrausta machaeralis* Walker (Lepidoptera: Pyralidae) in Prabhunagar Forest**. Indian Journal of Ecology 10(2): 204-209.

In Prabhunagar Forest, Karnataka, peak larval populations of *Pyrausta machaeralis* on teak occurred with increased adult populations in the last week of September.

3027 Patil, B.V; Thontadarya, T.S. 1987. **Biology of the teak skeletonizer, *Pyrausta machaeralis* Walker (Lepidoptera: Pyralidae)**. Mysore Journal of Agricultural Sciences 21(1): 32-39.

The biology of *Pyrausta machaeralis* was studied in the laboratory and field on teak in Karnataka.

3028 Patil, B.V; Thontadarya, T.S. 1987. **Correlation studies of the teak skeletonizer, *Pyrausta machaeralis* Walker with some biotic and abiotic factors**. Mysore Journal of Agricultural Sciences 21(2): 177-183.

The population dynamics of the pyralid *Pyrausta machaeralis* were studied in Karnataka. Populations of parasitoids and climatic factors, such as rainfall, relative humidity and maximum and minimum temperatures were significantly correlated with the different age intervals of the pest.

3029 Patil, B.V; Thontadarya, T.S. 1987. **Studies on the induction and termination of hibernation of the teak skeletonizer *Eutectona machaeralis* Walker (Lepidoptera: Pyralidae)**. Entomon 12(3): 179-182.

The factors responsible for the induction and termination of diapause in the teak pest *Eutectona machaeralis* were investigated in the laboratory. It is reported that termination of hibernation occurs when hibernating larvae are exposed to high temperatures and high relative humidities.

3030 Patil, S.U; Naik, M.I. 1996. **Cumulative effect of rearing *Trichogramma chilonis* Ishii on teak defoliator, *Hyblaea puera* Cramer and a laboratory host *Corcyra cephalonica* Stainton**. Indian Journal of Forestry 19(4): 368-370.

Parasitization by *T. chilonis* was slightly more on *H. puera* than on *C. cephalonica*, indicating the higher preference for *H. puera* eggs by *T. chilonis*.

3031 Patil, S.U; Naik, M.I. 1997. **Ovipositional trend and larval population pattern of teak defoliator, *Hyblaea puera* Cramer, at different heights of teak (*Tectona grandis* Linn.f.) trees**. Indian Journal of Forestry 20(2): 150-152.

Initially egg and larval populations were high in the top portion of the trees, but subsequently increased in the middle and the lower portions, because of defoliation at the top. Among the three tree heights high parasitization by *Trichogramma chilonis* was observed in bottom throughout the period of investigation.

3032 Pawar, C.S; Bhatnagar, V.S. 1989. **Seasonal activity of the teak defoliator *Hyblaea puera* Cramer (Lepidoptera: Hyblacidae) at ICRISAT, Patancheru, Andhra Pradesh**. Current Science 58(9): p521.

Field studies were conducted at ICRISAT in Andhra Pradesh to determine the activity of *H. puera* using light traps. The peak activity period was August-September. The origin of *H. puera* adults collected in the traps was not known.

3033 Pawar, C.S; Bhatnagar, V.S. 1990. **Seasonal activity of the teak defoliator *Hyblaea puera* Cramer (Lepidoptera: Hyblacidae) at ICRISAT Center, Patancheru, Andhra Pradesh**. Indian Journal of Forestry 13(2): 172-173.

Data are presented from monthly light trap catches of *Hyblaea puera*. The insect is a serious pest of teak and passes through 14 generations a year. Peak activity was recorded in July-October.

3034 Pearce, K.G; Hanapi, S. 1984. ***Acherontia lachesis* - a new pest of teak (*Tectona grandis*) in Malaysia**. Malaysian Forester 47(1/2): 80-81.

Larvae of *Acherontia lachesis* were found rapidly defoliating teak seedlings in Sarawak. They were preferring the larger, thicker mature leaves and also appearing to be attracted by leaf hairiness.

3035 Peres Filho, O; Dorval, A; Berti Filho, E. 2002. **Occurrence of the teak defoliator *Hyblaea puera* (Cramer, 1777) (Lepidoptera: Hyblaeidae) in teak (*Tectona grandis* Linn.f.) in Brazil**. Bragantia 61(1): 59-60.

Reported the occurrence of the *H. puera* in plantations of teak in Brazil.

3036 Prakasan, C.B; Kumar, P.K.V; Reddy, A.G.S. 1992. **Stink bug aggregation on vegetation in Waynaad**. Journal of Coffee Research 22(2): 135-138.

An aggregation of *Udonga montana* was noticed on vegetation in the Waynaad District of Kerala. The pentatomid was also found on forest trees including teak.

3037 Prasad, R; Meshram, P.B; Jamaluddin. 1990. **Possibilities for enhancing the fruiting in teak seed orchards**. Indian Forester 116(2): 99-102.

In teak seed orchards, insects such as fruit borer/inflorescence feeder and sap sucker were found to cause extensive damage. Besides these insects teak defoliator, *Hyblaea puera* and skeletoniser, *Eutectona machaeralis* also reduce the vigour of plants.

3038 Premrasme, T; Smitinand, T; Ghaiglom, D. 1963. **Research on the destruction by and protection from attack of the teak bee-hole borer (*Xyleutes ceramicus* walker)**. (Thai). Royal Forest Department, Bangkok, Research Report: 20p. Teak Improvement Centre, Ngao.

3039 Premrasme, T; Smitinand, T; Sahibuli, T; Ghaiglom, D. 1966. **Studies on the biology, ecology and control of teak bee-hole borer *Xyleutes ceramicus*-walker in the Northern plantation teak forest**. Royal Forest Department, Bangkok, Research Report: 19p.

3040 Rajak, R.C; Agarwal, G.P; Khan, A.R; Sandhu, S.S. 1993. **Susceptibility of teak defoliator (*Hyblaea puera* Cramer) and teak skeletonizer (*Eutectona machaeralis* Walker) to *Beauveria bassiana* (Bals.) Vuill**. Indian Journal of Experimental Biology 31(1): 80-82.

Laboratory studies showed that susceptibility of *Hyblaea puera* and *Eutectona machaeralis*, both pests of *Tectona grandis*, to *Beauveria bassiana* was influenced by larval age. Infectivity decreased with an increase in larval age.

3041 Rajak, R.C; Sandhu, S.S; Khan, A.R; Agarwal, G.P. 1990. **Susceptibility of teak defoliator and teak skeletonizer (Lepidoptera: Noctuidae) to *Beauveria bassiana*: Effects of instar, dosage and temperature**. Proceedings and abstracts. Vth International Colloquium on Invertebrate Pathology and Microbial Control, Adelaide, Australia, 20-24 August 1990: p153. Department of Entomology, University of Adelaide, Glen Osmond, Australia.

The susceptibility of larvae of *Hyblaea puera* and *Eutectona machaeralis* to *Beauveria bassiana* was studied. Mortality decreased with increase in age of larvae. Maximum mortality was recorded in 2nd-instar larvae of *H. puera* and *E. machaeralis*.

3042 Raman, S; Das, S.N. 1980. **Population density of plant-parasitic nematodes associated with some forest trees in Orissa**. Indian Forester 106(9): 621-624.

Nematode genera present in the root zone and their density are tabulated for 28 species. Maximum numbers were on *Tectona grandis*.

3043 Rane, N; Ghate, H. 1997. **The buprestid, *Psiloptera fastuosa* Fabr**. Insect Environment 3(2): p29.

Psiloptera fastuosa was reported to be a pest of teak.

3044 Rappard, F.W. 1950. **Aphids on teak**. (Dutch). Tectona 40(2): 160-162.

Damage is very slight, but severe infestation of the underside of half-grown leaves will cause them to shrivel.

3045 Rappard, F.W. 1950. **The snail *Achatina fulica*, a danger to young teak plantations**. (Dutch). Tectona 40(3/4): 365-366.

Infestation destroyed 90 percent of 1st-year nursery seedlings both leading shoots and side leaves being eaten.

3046 Rativanichi, T; Weissmann, G. 1973. **Chemical constitutions of teak (*Tectona grandis*) and their influence on the attack of the beehole borer (*Xyleutes ceramicus*)**. Natural History Bulletin of the Siam Society 24(3/4).

Samples of teak wood which were attacked or not attacked by the teak beehole borer were investigated. *Beauveria bassiana* has been tested and is found effective when the larvae have developed to maturity.

3047 Remadevi, O.K; Muthukrishnan, R; Srinivasa, Y.B. 2003. **Clonal variation in the incidence of phytophagous insects - some thoughts on divergence of teak**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

The population divergence of teak across the state of Karnataka, with respect to the incidence of phytophagous insects is studied. Variation in the incidence of *A. dispersus* was detected across individual clones indicating divergence in the populations of teak.

3048 Remadevi, O.K; Sivaramakrishnan, V.R. 1996. **Biomass utilisation by *Diacrisia obliqua* Walker feeding on *Tectona grandis* Linn.f. and *Parthenium hysterophorus* L**. Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium, Peechi, 23-26 November 1993: 441-447. K.S.S. Nair; J.K. Sharma; R.V. Varma, Eds. Kerala Forest Research Institute, Peechi.

The polyphagous arctiid pest *Diacrisia obliqua* feeds on the leaves of both teak tree and the weed, *Parthenium hysterophorus*. The nutritional indices on both the plants were studied simultaneously and compared. It is shown that *Parthenium* is nutritionally more suitable for the growth and survival of *S. obliqua*, although leaf consumption was higher for teak.

3049 Roonwal, M.L. 1954. **Biology and ecology of oriental termites (Isoptera). No. 1: *Odontotermes parvidens* Holmg. and Holmg. severly damaging the bark and contributing to the death of standing teak trees in Uttar Pradesh, India. No. 2: On ecological adjustment in nature between two species of termite, *Coptotermes heimi* (Wasm.) and *Odontotermes redemanni* (Wasm.) in Madhya Pradesh, India**. Journal of the Bombay Natural History Society 52(2/3): 459-467.

The termite *O. parvidens* destroyed the bark and killing the cambium, and causing a girdling effect.

3050 Roychoudhury, N. 1999. **Spinning behaviour and pupal-web formation in teak leaf skeletonizer, *Eutectona machaeralis***. Indian Journal of Entomology 61(3): 296-298.

3051 Roychoudhury, N. 1999. **Teak defoliator and host plants: An ecological relationship**. Advances in Forestry Research in India 20: 182-189.

An update of the alternative host plants of the teak defoliator, *Hyblaea puera* is presented.

3052 Roychoudhury, N; Jain, A; Joshi, K.C. 1995. **Alteration of growth and development in leaf skeletonizer *Eutectona machaeralis* Walker, due to variations in teak leaves of different maturity**. Indian Journal of Experimental Biology 33(3): 227-229.

Measurements were made of the differences among teak leaves of different degrees of maturity for growth and development of *Eutectona machaeralis*. Tender leaves contained relatively high percentages of water, nitrogen and polyphenol contents and there was a rapid decline in intermediate and mature leaves.

3053 Roychoudhury, N; Joshi, K.C. 1995. **Larval feeding habits and moulting behaviour of *Hyblaea puera* Cramer on teak**. Advances in Forestry Research in India 12: 228-233.

A review of studies in India on the pest of teak.

3054 Roychoudhury, N; Joshi, K.C; Pal, R. 1997. **Larval feeding preference of leaf skeletonizer *Eutectona machaeralis* walker, on teak leaves of different levels of maturity**. Advances in Forestry Research in India 16: 172-179.

Measurements were made of the larval feeding preference of *Eutectona machaeralis* for teak leaves of different maturity through bioassays in the laboratory. Leaf consumption by area was found to be significantly more on tender leaves, followed by intermediate and mature leaves.

3055 Roychoudhury, N; Joshi, K.C. 1997. **Larval feeding habits and moulting behaviour of leaf skeletonizer, *Eutectona machaeralis* Walker, on teak**. Indian Forester 123(5): 438-439.

A brief descriptive account is given.

3056 Roychoudhury, N; Joshi, K.C. 2000. **Natural resistance in teak to *Spodoptera litura* (Fabricius) Boursin (Lepidoptera: Noctuidae)**. Indian Forester 126(7): 792-796.

Nine selected plus tree progenies of teak from Orissa, Andhra Pradesh, Tamil Nadu and Maharashtra were evaluated for their natural variation in resistance to *Spodoptera litura*, a major pest of teak at the nursery stage in Madhya Pradesh. Plus tree progeny of one from Orissa and another from Andhra Pradesh were the most resistance and most susceptible.

3057 Roychoudhury, N; Kalia, S; Joshi, K.C. 1995. **Pest status and larval feeding preference of *Spodoptera litura* (Fabricius) Boursin (Lepidoptera: Noctuidae) on teak**. Indian Forester 121(6): 581-583.

Surveys were carried out of insect pests damaging teak at the nursery stage at Jabalpur, Madhya Pradesh. Serious damage was observed from attack by *Spodoptera litura*. Brief details are given of the life cycle of the pest on teak seedlings.

3058 Rutherford. 1913. ***Zeuzera coffeae* Nieta (Red borers)**. Tropical Agriculturist, Ceylon 41(6): 486-488.

3059 Sajeev, T.V. 1999. **Spatial dynamics of teak defoliator (*Hyblaea puera* Cramer) outbreaks: Patterns and causes**. Ph.D Thesis. Cochin University of Science and Technology.

It is found that the outbreaks of the species originate by the population build up in small epicentres from where it spreads to larger areas over successive generations.

3060 Sands, W.A. 1960. **Observations on termites destructive to trees and crops**. Colonial Termite Research, Commonwealth Institute of Entomology, London 1956-60: 14-66.

Damage caused to teak by *Amitermes evuncifer, Microcerotermes* sp. and *Microtermes* sp. are reported.

3061 Santhakumaran, L.N. 1985. **Marine wood borers of India, an annotated bibliography**. Wood Preservation Centre (Marine), National Institute of Oceanography, Dona Paula, Goa: 147p.

3062 Santhakumaran, L.N. 1988. **Marine wood borers of India, an annotated bibliography**. Wood Preservation Centre (Marine), National Institute of Oceanography, Dona Paula, Goa: 56p.

3063 Santhosh, K; Kumar, P. 2002. **Studies on infestation status of teak trunk borer *Alcterogystia cadambae* Moore (Lepidoptera: Cossidae) in clonal seed orchards of Karnataka**. Myforest 38(4): 365-371.

Influence of locality on trunk borer incidence was significant which could be due to a difference in exposure of these seed orchards to pest attack or may be the clones were more resistant to borer attack.

3064 Santosh, K; Kumar, P. 2003. **New incidence of *Alcterogystia cadambae* Moore. (Lepidoptera: Cossidae) on *Butea monosperma* Taub**. Myforest 39(1): 89-91.

It is reported that *Butea monosperma* trees growing naturally in and around teak plantations were found infested by *A. cadambae*, the trunk borer.

3065 Sarvottam Rao, C. 1968. **Identification and control of insect borer in teak plantation-Itkial range-Pembi**. Indian Forester 94(8): 649-650.

The root and shoot boring insect has been identified as *Calesterna scabrator*. Certain silvicultural measures are suggested for the control.

3066 Schmidt, H. 1968. **A test method with the subterranean termite *Reticulitermes* on tropical woods**. (German). Holz als Roh-und Werkstoff 26(9): 342-343.

The termite-repellent properties of many tropical timbers delay the onset of attack. Tests with *R. flavipes* on 7 timbers including teak from Thailand are described. *Tectona grandis* was attacked after two years.

3067 Scott, C.W. 1932. **Measurement of the damage to teak timber by the beehole borer moth, *Xyleutes* (*Duomitus caramicus*) with special reference to relative severity in plantations and natural forest and to variation with rainfall and position in the tree**. Burma Forest Bulletin 29 (Economic series 6): 10p.

Damage which is proportional to rainfall and also to increasing altitude. Plantation teak is more bee-holed than natural forest teak and this rainfall index can be used for gauging value of teak plantations, bee-hole damage and for raising plantations.

3068 Sen Sarma, P.K; Thakur, M.L; Misra, S.C; Gupta, B.K. 1975. **Studies on wood destroying termites in relation to natural termite resistance of timber**. Final Technical Report 1968-73: 187p. Forest Research Institute, Dehra Dun.

This report dealt with the identity, distribution and economic significance of wood destroying termites, with the mass-rearing of *Neotermes bosei* Snyder, *Coptotermes heimi* and *Microcerotermes beesoni* Snyder, with the selection of teak trees with a high termite resistance index, with the natural resistance of timber to termites.

3069 Sevastopulo, D.G. 1951. **A supplementary list of the food plants of the Indian Bombycidae and Agaristidae and Noctuidae**. Journal of the Bombay Natural History Society 48: p271.

Teak is reported as the host plant of *Cossus cadambae*.

3070 Silva, M.D de. 1961. ***Empoasca punjabensis* Pruthi, a newly recorded pest of teak in Ceylon**. Tropical Agriculturist, Ceylon 117(3): 203-204.

A note on this leafhopper, found causing malformations of teak leaves.

3071 Singh, B. 1955. **Description and systematic position of larva and pupa of the teak defoliator, *Hyblaea puera* Cramer (Insecta, Lepidoptera, Hyblaeidae)**. Indian Forest Records (n.s.) Entomology 9(1): 1-16.

The study justifies the erection of the family Hyblaeidae for the genus *Hyblaea*, and its separation from the *Noctuidae*.

3072 Singh, P; Misra, R.M. 1987. **New record of *Beauveria tenella* (Delacroix) Siemaszko on teak skeletonizer *Eutectona machaeralis* Walker (Lepidoptera: Pyralidae)**. Indian Forester 113(7): 476-478.

An investigation of the chronic and severe epidemics of *Eutectona machaeralis* which occur in the teak forests of Melghat, Maharashtra was made. The progressive changes occurring after spraying fungal spores onto larvae in the laboratory are described. It is suggested that *B. tenella* could be used successfully in biological control of *E. machaeralis*.

3073 Singh, P; Misra, R.M; Singh, R. 1990. **External morphology, bionomics and natural enemies of *Pagyda salvalis* Walker (Lepidoptera: Pyralidae) the inflorescence feeder and fruit borer of teak**. Indian Forester 116(9): 742-747.

Observations of *P. salvalis* are reported based on insect studies and field surveys carried out in teak forests in Uttar Pradesh, Tamil Nadu and Maharashtra. Three generations were recorded from June to October, and the pest was observed feeding on *Callicarpa lantana* and on teak.

3074 Singh, S; Puri, Y.N; Bakshi, B.K. 1973. **Decay in relation to management of dry coppice teak forests**. Indian Forester 99(7): 421-430.

In studies in two cutting areas in Gujarat State, where trees were coppiced at six different heights of 0, 5.25 cm above ground. Stools coppiced at heights of 10-15 cm produced the largest number of low side shoots and the fewest high side shoots or callus shoots, and this height is recommended for further coppicing.

3075 Soda, R; Nakamura, K; Matsune, K; Nakama, E; Harada, Y; Sasaki, S. 2000. **Insect damage on mahogany and teak trees in East Kalimantan, Indonesia**. Bio technology applications for reforestation and biodiversity conservation. Proceedings of the 8th International Workshop of BIO REFOR, Kathmandu, Nepal, 28 November-2 December 1999: 109-111. M.S. Bista; R.B. Joshi; S.M. Amatya; A.V. Parajuli; M.K. Adhikari; H.K. Saiju; R. Thakur; K. Suzuki; K. Ishii, Eds. BIO REFOR, Ministry of Forests and Soil Conservation, Kathmandu, Nepal.

Teak beehole borer, *Xyleutes ceramica* which damages teak stems. Sixteen percent of 5-yr-old teak trees were damaged. The insect made holes in the bottom of stem and many holes were observed in the heartwood.

3076 Speight, M.R. 1996. **The relationship between host tree stresses and insect attack in tropical forest plantations and its relevance to pest management**. Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium, Peechi, India, 23-26 November 1993: 363-372. K.S.S. Nair; J.K. Sharma; R.V. Varma, Eds. Kerala Forest Research Institute, Peechi, India.

The role of stress originating from environmental factors in insect-host interactions in tropical trees is discussed and the literature reviewed. A computer-based site-matching system was used to investigate the suitability of the five sites to the chosen tree species. In four of the five cases, the trees attacked by insects were growing in environment not suited for the trees. The importance of pest management by preventative means which involve the minimising of risk from insect attack at the planning stage is emphasised.

3077 Sri Esti Intari. 1978. **Some important pests of forest trees in Indonesia**. Proceedings of the 8th World Forestry Congress, Jakarta, 16-28 October 1978, World Forestry Congress: Forestry for industrial development FID-0-11: 6p.

Brief notes are given on Neotermes tectonae, Pyrausta machaeralis and Hyblaea puera on Tectona grandis.

3078 Srinivasan, T.K. 1955. **Crustaceans in relation to underwater timber structures**. Current Science 24(10): p342.

A survey was made of crustaceans associated with underwater timbers of the Madras coast. The most important borers are *Sphoerama vastator, S. walkeri, Exosphoeroma* sp. and *Metoponorthus pruinosus* which damage structures of species including teak.

3079 Starte, H.W. 1926. **Rats attacking teak seedlings**. Indian Forester 52(3): 132-133.

Reports teak seedlings upto 1" diameter or more nibbled by rats at collar level.

3080 Stebbing, E.P. 1899. **Injurious insects of Indian forests**. *Hapalia machaeralis*: p115; 119-121, *Hyblaea puera*: 115-117; 120-132, *Cossus cadambae*: 102-104. Government of India Press, Calcutta.

Gives notes on Hapalia machaeralis, Hyblaea puera and Cossus cadambae attacking teak forests.

3081 Stebbing, E.P. 1901. **Forest Pests. I. Teak tree pests**. Indian Forester 26(5): p391; 516-517, 27(5): 72-74; 243; 247-248.

3082 Stebbing, E.P. 1902. **Injurious insects of Indian forests**. Indian Forester 28: 389-390.

Covered insect pests of teak.

3083 Stebbing, E.P. 1903. **Forests pests I. Teak tree pests *Hyblaea puera***. Indian Forester 29(5): p183.

3084 Stebbing, E.P. 1903. **The insect world in an Indian forest and how to study it. Part VI**. Indian Forester 29(5): 178-186.

The various families in the sub-order are described and *Cossus cadambae* is listed as harmful to teak.

3085 Stebbing, E.P. 1905. **A note on the beehole borer of teak in Burma**. Indian Forest Bulletin (Entomology Series) 1: 1-19.

3086 Stebbing, E.P. 1907. ***Icerya aegyptica*, Dougl. on teak in Burma**. Indian Forester 33(5): 222-224.

3087 Stebbing, E.P. 1908. **The teak defoliator**. Indian Forest Leaflet (Zoology Series) 2: 5p.

Describes the nature of attack, distribution, general appearance, damage committed in forest, natural enemies and protection of *Hyblaea puera*.

3088 Stebbing, E.P. 1908. **The teak leaf skeletioniser**. Indian Forest Leaflet (Zoology Series) 3: 8p.

Describes the nature of attack, distribution, general appearance, damage committed in forest, natural enemies and protection of *Pyrausta machaeralis*.

3089 Stebbing, E.P. 1915. **Indian forest Coleoptera**. Tectona 8: 566-570.

Attack with partial to complete defoliation causing curling and gall formation on undersurface of leaves, later upper surface, blackens, decays or drops.

3090 Sudheendrakumar, V.V. 1986. **Studies on the natural enemies of the teak pests, *Hyblaea puera* and *Eutectona machaeralis***. KFRI Research Report 38: 28p. Kerala Forest Research Institute, Peechi.

The natural enemies include five parasites - *Brachymeria lasus, Palexorista solennis, Sympiesis* sp. and two species of unidentified ichneumonid wasps, two insect predators, four species of birds and a species of bacterial pathogen *Enterobacter aerogenes*.

3091 Sudheendrakumar, V.V; Nair, K.S.S; Varma, R.V. 1988. **Seasonal incidence of *Eutectona machaeralis* (Walker) in teak plantations at Nilambur, Kerala**. Indian Journal of Forestry 11(3): 250-253.

Seasonal incidence was studied by visual scoring of the defoliation. It is reported that late season outbreaks of *E. machaeralis* are not regular phenomenon in teak plantations in Kerala and that outbreak may be heavy and widespread in exceptional years.

3092 Sudheendrakumar, V.V; Ali, M.I.M; Varma, R.V. 1988. **Nuclear polyhedrosis virus of the teak defoliator, *Hyblaea puera***. Journal of Invertebrate Pathology 51(3): 307-308.

The pathogens of *Hyblaea puera* were surveyed in teak plantations in Kerala. A nuclear polyhedrosis virus was isolated from dead larvae and its pathogenicity was confirmed in the laboratory.

3093 Sudheendrakumar, V.V; Ali, M.I.M; Mohanadas, K. 1990. **Studies on the bacterial pathogens associated with the teak defoliator, *Hyblaea puera* Cramer**. Proceedings of the IUFRO Regional Workshop on Pest and Diseases of Forest Plantations, Bangkok, 1988: 1-4. C. Hutacharern, et al, Eds. FORSPA, Bangkok.

Four bacteria, *Bacillus thuringiensis, Enterobacter aerogenes, Serratia marcescens* and *Pseudomonas aeruginosa* were isolated in pure culture and pathogenicity confirmed in artificial inoculation trials. Preliminary laboratory studies indicated that *B. thuringiensis* is the most effective bacterium causing mortality of the larvae of *H. puera*. Potential of these organisms in biological control of *H. puera* is discussed.

3094 Sudheendrakumar, V.V. 1994. **Pest of teak and their management**. Forest Entomology: 121-140. L.K. Jha; P.K. Sen Sharma, Eds. Ashish Publishing House, New Delhi.

About 171 species of insects are associated with living teak. The pests of teak can be divided into two groups, leaf feeders and trunk borers. The leaf feeders include the lepidoptera, *Hyblaea puera* and *Eutectona machaeralis*. The trunk borers include *Sahyadrassus malabaricus* and *Alcterogystia cadambae*. The biology, seasonal incidence pattern, impact and control strategies of the important pests are discussed.

3095 Sudheendrakumar, V.V; Jalali, S.K; Singh, S.P. 1995. **Acceptance of the teak defoliator, *Hyblaea puera* (Cramer) (Lepidoptera: Hyblaeidae) by two exotic species of *Trichogramma* (Hynenoptera: Trichogrammatidae).** Journal of Biological Control 1: 43-44.

Two arboreal species of *Trichogramma* namely, *T. embryophagum* and *T. dendrolimi* were evaluated in the laboratory for their efficacy in parasitising the teak defoliator eggs. Parasitism caused by *T. embyophagum* was significantly higher than that of *T. dendrolimi* and the highest parasitism occurred under the parasitoid - host ratio of 1:4.

3096 Sudheendrakumar, V.V. 2003. **Reproductive behaviour of *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidae)**. Entomon 28(2): 77-84.

The reproductive behaviour of the teak defoliator, *Hyblaea puera* was studied under laboratory conditions.

3097 Suharti, M; Intari, S.E. 1974. **Guide to the identification of several pests and diseases of teak (*Tectona grandis*)**. Laporan, Lembaga Penelitian Hutan 182: 42p.

3098 Sundararaj, R; Remadevi, O.K; Rajamuthukrishnan. 2000. **Intensity of whitefly *Aleurodicus dispersus* Russell (Aleyrodidae: Homoptera) on forest and avenue trees in and around Bangalore (India)**. Indian Journal of Forestry 23(3): 319-321.

Eggs, nymphs and adults of the while fly, *Aleurodicus dispersus* were observed infesting the leaves of important avenue trees and forest tree species in Karnataka especially teak.

3099 Supriana, N. 1988. **Feeding preference behaviour of *Cryptotermes cynocephalus* Light and *Coptotermes curvignathus* Holmgren on twenty eight tropical timbers**. Jurnal Penelitian dan Pengembangan Kehutanan 4(2): 1-5.

A study was made of the comparative resistance and repellency of 28 tropical timbers to the dry wood termite, *Cryptotermes cynocephalus* and the subterranean termite, *Coptotermes curvignathus*. The most repellent species to *C. cynocephalus* include *Tectona grandis*. The relation of the results to the relative hardness of the wood species is discussed.

3100 Suratmo, F.G. 1982. **Pest management in forestry**. Protection Ecology 4(3): 291-296.

Progress in forest pest management in Thailand, Malaysia, Philippines and Indonesia is reviewed and the widespread insect pests of certain forest trees including teak are discussed in relation to the damage caused by them. The current development of industrial monoculture plantations in South-East Asia is likely to result in greater pest problems, increasing the need for improved forest pest management activity in the region.

3101 Suratmo, F.G. 1996. **Emerging insect pest problems in tropical plantation forest in Indonesia**. Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium, Peechi, 23-26 November 1993: 502-506. K.S.S. Nair; J.K. Sharma; R.V. Varma, Eds. Kerala Forest Research Institute, Peechi.

Plantations of forest trees including teak have been raised in Indonesia for more than 100 years. Several insect pests are reported to attack these plantations, which include *Xyleborus destruens*, *Hyblaea puera*, *Pyrausta machaeralis* and termites on teak. Insect pest problems of these species are discussed.

3102 Sushil Kumar; Thakur, M.I. 1989. **Damage to nursery stock by a rodent *Nesokia indica* (Gray) at Satyanarayan Forest Nursery, Dehra Dun (Uttar Pradesh)**. Indian Forester 115(3): 177-179.

A brief account of the nature and extent of damage caused by the rat, *N. indica* to stock at the nursery is given. Damage was found to the tap roots of newly germinated and 1-yr-old seedlings of trees including *Tectona grandis*.

3103 Swaran, P.R; Varma, R.V. 2001. **Root feeding termites - an emerging problem in root trainer raised teak seedlings in Kerala**. Annals of Forestry 9(2): 331-332.

Over 20 percent of the out-planted seedlings were found either killed or severely damaged by subterranean termites.

3104 Szen, I.S.T; Vany, J.J.H; Womersley, J.S. 1958. **Some Insects in forest trees of New Guinea**. Proceedings of the 10th International Congress Entomology Montreal. 1956 4: 331-334.

Hyblaea puera is the important pest of teak.

3105 Thakur, M.L. 1983. **Insect factor in forest tree improvement programme**. Journal of the Indian Academy of Wood Science 14(1): 26-34.

A review of current pest problems of forest trees including *Tectona grandis* and a discussion of the role of tree breeding in prevention and control.

3106 Thakur, R.K; Rathore, N.S. 1982. **On the occurrence of *Cryptotermes bengalensis* Snyder (Isoptera: Kalotermitidae) in Gujarat, India**. Journal of the Bombay Natural History Society 79(3): 699-700.

Cryptotermes bengalensis was found attacking dead portions of a living teak in the Kaprada Forests, Bulsar District, Gujarat and this is of the first record of the termite from the state.

3107 Thompson, R.C. 1897. **Insect ravages among teak and *Anogeissus latifolia***. Indian Forester 23: p325.

3108 Tilakaratna, D. 1995. **Life history of the teak defoliator, *Hyblaea puera***. Sri Lanka Forester 22(1/2): 25-28.

The life history of *Hyblaea puera* was studied under the laboratory conditions with the objective of determining the duration and behaviour of various stages of the insect's life under Sri Lankan conditions. It was found that the complete life cycle takes 21-33 days.

3109 Tiwari, S.D.N. 1954. **The sapling borer of teak**. Indian Forester 80(8): 433-434.

A short note on a new cerambycid borer, found in teak plantations in Bastar State, which has been identified as *Coelosterna* sp.

3110 Tiwari, S.D.N. 1958. **Teak defoliator**. Indian Forester 84(10): p647.

Mentions about teak defoliation occurring in high intensity attributed to drought. Abundance of *Hapalia mechaeralis* is attributed to the climate of the locality.

3111 Troup, R.S. 1901. **A teak-boring molluse**. Indian Forester 27(10): p492.

Martesia fluminalis reported from brackish waters of Pegu canal, Lower Burma, is said to cause damage of stored teak logs. The animal is found in the cross-section of wood in a cavity, which shows that it gets in when small and grows bigger inside.

3112 Vaishampayan, S.M; Verma, R; Bhowmik, A.K. 1987. **Possible migration of teak-defoliator, *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidae) in relation to the movement of the south-west monsoon as indicated by light trap catches**. Indian Journal of Agricultural Sciences 57(1): 41-46.

Light trap data showed that the activity of *H. puera* in the teak forests of E. Madhya Pradesh was closely linked with the movement of the monsoon. Moths first appeared with the arrival of the monsoon. Delay in the arrival of the monsoon reduced pest activity.

3113 Varma, B.A; Sudhakara, K; Bhaskar, B. 1996. **Insect pests associated with nurseries of selected tree crops in Kerala**. Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium, Peechi, 23-26 November 1993: 468-473. K.S.S. Nair; J.K. Sharma; R.V. Varma, Eds. Kerala Forest Research Institute, Peechi.

Seven tree species raised in the nursery which include *Tectona grandis* suffered greater pest damage. Most damage was caused by leaf feeding and root feeding insects such as *Hyblaea puera*, *Eligma narcissus* and *Eurema blanda*.

3114 Varma, R.V. 1997. **White grub damage and its control in teak nurseries**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 84-85. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

White grubs cause serious damage to teak seedlings in many nurseries. Two organophosphate insecticides - Phorate 10G and Carbofuran 3G were tested in a white grub infested teak nursery and the insecticides proved effective in preventing further damage.

3115 Varma, R.V; Sudheendrakumar, V.V; Nair, K.S.S; Mohanadas, K. 1998. **Establishment of permanent plots to demonstrate the effect of protecting teak plantations from the teak defoliator**. KFRI Research Report 163: 15p. Kerala Forest Research Institute, Peechi.

Permanent plots were established and maintained in a young teak plantation at panayangode in the Nilambur Forest Division to demonstrate the impact of defoliation caused by the insect *Hyblaea puera* on growth of teak. In the protected plot there was 45 percent increase in mean height and 19 per cent increase in GBH over the control.

3116 Varma, R.V; Sudheendrakumar, V.V; Sajeev, T.V. 2001. **Assessment of pest problems in intensively managed STM teak plantations**. KFRI Research Report 198: 12p. Kerala Forest Research Institute, Peechi.

A study was made to identify and the impact of major pests in intensively managed teak plantations of Sterling Tree Magnum Company and to examine how the intensive management practices like irrigation and fertilizer applications affect the pest dynamics. The major pests recorded were the teak defoliator, *Hyblaea puera* and the teak skeletonizer, *Eutectona machaeralis*.

3117 Vastrad, A.S; Rai, P.S; Kulkarni, K.A. 1989. **Occurrence of *Eucoptacra ceylonica* Kirby (Coptacridinae: Acrididae: Orthoptera) in India**. Entomon 14(3/4): 277-279.

Eucoptacra ceylonica was recorded for the first time in India and the adults were found feeding on the leaves of plants including *Tectona grandis*. A key to the species of the genus *Eucoptacra* is provided.

3118 Veenakumari, K; Mohanraj, P. 1996. **Folivorous insects damaging teak, *Tectona grandis* Linn.f. (Verbenaceae) in the Andaman Islands, Bay of Bengal, Indian Ocean**. Journal of Entomological Research 20(2): 177-178.

Teak was introduced into the Andaman and Nicobar Islands. It was recorded to be extensively damaged by the lepidopteran teak defoliator, *Hyblaea puera*.

3119 Verbeek, F.A.T.H. 1930. **The teak defoliator *Hyblaea puera* Cram**. (Dutch; English). Tectona 33: 104-112.

3120 Villar, A.R. 1916. **Beehole borers and a tucktoo**. Indian Forester 42(10): 512-514.

Describes the life history, stages and behaviour of the moth *Duomitus ceramicus*. The high mortality of the moths and eggs is attributed to a tucktoo, a friend of forests of Burma.

3121 Wang, P.Y; Sung, S.M. 1980. **On taxonomic status of the teak leaf skeletonizer, *Pyrausta machaeralis* Walker, with establishment of a new genus**. (Chinese; English). Acta Entomologica Sinica 23(3): 305-307.

Pyrausta machaeralis, an important pest of teak in tropical Asia. The characters of the genus are given.

3122 Wu, S.H; Chen, C.C; Wang, T.H. 1979. **A preliminary study on the teak defoliator *Pyrausta machaeralis* Walker**. Acta Entomologica Sinica 22(2): 156-163.

Larvae spun webs and fed on leaf tissues between veins. Adults stay in shade. A total of 18 species of natural enemies were found in the field.

3123 Wu, W.N; Li, Z.Q. 1984. **Three new species of the genus Phytoseius from South China (Acarina: Phytoseiidae)**. Acta Entomologica Sinica 27(4): 457-461.

The species include P. silvaticus from Tectona grandis.

3124 Yadav, A.S; Khare, P.K. 1988. **Observations on insect attack, leaf-fall and leafing period in teak**. Canopy International 14(1): p11.

A brief report on the infestation of teak in a tropical dry deciduous site at Gopalpura reserved forest, Madhya Pradesh, by the teak defoliator, *Hyblaea puera* and the teak skeletonizer, *Hapalia machaeralis*.

3125 Yeole, P.R. 1991. **Teak girdler larva**. Indian Forester 117(4): 286-287.

An infestation by an unidentified larva is reported from a teak seed orchard in Mohogata Research Centre, Maharashtra which was found in the soil at the base of the trees is briefly described.

3126 Zethner, O. 1970. **Defoliations of teak by *Hyblaea puera* Cr. in East Pakistan**. Forest Dale News 2(4): 45-49.

Data on the serious damage to teak plantations caused by *H. puera* in parts of Chittagong.

3127 Zethner, O. 1973. **Entomological problems in forests in the Indian subcontinent with examples from Pakistan and Bangladesh**. Entomologiske Meddelelser 41(3): 129-143.

Reviews and discusses the different types of forests in these regions and the principal insect pests that attack the trees. The most important insect pests that attack logs and other felled wood, plantations and nurseries are enumerated.

3128 Zethner, O; Choudhury, J; Das Gupta S.R. 1972. **Preliminary studies on forest insects in East Bengal**. FAO Report FAO: UNDP-66-530: 40p.

A compilation of four papers which include the paper entitled, a note on distribution and control of teak defoliators in Bangladesh. *H. puera* and *Hapalia machaeralis* are the important defoliators of *Tectona grandis*. A list is given of trees and shrubs suitable for introduction into teak plantations in order to provide a source of insect hosts to maintain a population of parasites.

Go top

Go top

Biological Control

(See also 3090)

3129 Agarwal, G.P; Rajak, R.C; Katare, P; Sandhu, S.S. 1985. **Studies on entomogenous fungi parasitizing insect pests of teak**. Journal of Tropical Forestry 1(1): 91-94.

The fungi *Beauveria bassiana* and *Fusarium* sp. were isolated from *Hyblaea puera* and *Pyrausta machaeralis* in Jabalpur, Madhya Pradesh. Healthy, laboratory-reared eggs, larvae, pupae and moths were sprayed with a suspension of conidial spores. *Fusarium* was found more effective against both moths.

3130 Ahmed, S.I. 1995. **Investigations on the nuclear polyhedrosis of teak defoliator, *Hyblaea puera* (Cram) (Lep., Hyblaeidae)**. Journal of Applied Entomology 119(5): 351-354.

Laboratory studies were carried out on the infection of *Hyblaea puera* with nuclear polyhedrosis virus to gain an understanding of the insect-virus relationship.

3131 Ali, M.I.M; Sudheendrakumar, V.V. 1997. **Possible use of microbial pathogens against teak pests**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 93-99. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

A disease of the teak defoliator *Hyblaea puera* caused by a nuclear polyhedral virus was observed in various teak plantations. Bioassay studies revealed that the virus is highly pathogenic to *H. puera*. Three species of bacterial pathogens, viz. Bacillus cereus, *B. thuringiensis* var *thuringiensis* and *Enterobacter aerogenes* were also recorded from *H. puera*. The fungal pathogen *Beauveria bassiana* was found to cause larval mortality of the teak sapling borer *Sahyadrassus malabaricus*.

3132 Ali, M.I.M; Varma, R.V; Sudheendrakumar, V.V. 1991. **Evaluation of microbial pathogens for biocontrol against important insect pests of Ailanthus and teak**. KFRI Research Report 72: 44p. Kerala Forest Research Institute, Peechi.

The results are reported of laboratory tests carried out on the potential effectiveness in biological control of viral, fungal and bacterial pathogens isolated from pests of teak and *Ailanthus triphysa* in Kerala. The teak pests studied were the teak defoliator, *Hyblaea puera* and the teak sapling borer, *Sahyadrassus malabaricus*.

3133 Atkinson, D.J. 1933. **On life history, analysis of past attacks and natural enemies**. Burma Annual Report on working plans, Silviculture and Entomology for 1931-32: 61-65.

3134 Atkinson, D.J. 1933. **Preliminary note on the shot-holing of converted teak**. Indian Forester 59(4); 226-232.

Notes on shot-holing of teak, attributed to *Tribolium castaneum* and *Dinoderus pilifrons* and *Xyleborus* spp. and other ambrosia beetles of family Platypodidae, etc. is given.

3135 Beeson, C.F.C. 1934. **The biological control of teak defoliators**. Indian Forester 60(10): 672-683.

The author recommends use of natural remedies to control defoliation.

3136 Beeson, C.F.C. 1938. **Undergrowth and the biological control of teak defoliators**. Indian Forester 64(8): 485-492.

The value of undergrowth in biological control of defoliators in teak plantations was investigated and listed species of useful plants based on host-parasite relationships.

3137 Beeson, C.F.C; Chatterjee, P.N. 1939. **Further notes on the biology of parasites of teak defoliators in India**. Indian Forest Records (n.s.) Entomology 5: 355-379.

Additional data on distribution, hosts, life-cycles, etc. are given for 23 hymenopterous and 6 dipterous species of parasites of teak defoliators in India. Experiments in the introduction and colonization of parasites between Burma and India and vice versa are described. Data are recorded on the parasitism percentages of *Hapalia machaeralis*, *Hyblaea puera*, *Lygropia quaternalis* and *Sylepta* spp.

3138 Bhatia, B.M. 1941. **On the plant-defoliator-parasite complex in the biological control of teak defoliators**. (English). Indian Forest Records 7(6): 193-211 .

Gives a list of host plants for association with teak for the biological control of two chief defoliators *Hapalia machaeralis* and *Hyblaea puera*.

3139 Braithwaite, J.D. 1942. **Notes on research into the parasite of the beehole borer of teak**. Empire Forestry Journal 21: 120-122.

The author describes some successful laboratory experiments in the breeding of *Nemeritris tectonae*, the first ever undertaken with this species.

3140 Chadhar, S.K. 1996. **Field evaluation of *Bacillus thuringiensis* (a biopesticide) in relation to control of teak skeletoniser**. Vaniki Sandesh 20(1): 1-6.

A 6-yr-old plantation of teak in Madhya Pradesh, infested with the teak skeletonizer, *Pyrausta machaeralis*, were treated with *Bacillus thuringiensis* spray . Leaves affected by the pest were counted before and after treatment in control and treated plots. Differences in the percentage of leaves skeletonized were marginal between the treatments.

3141 Chatterjee, P.N. 1938. **Cytoplasmic inclusions in the cogenesis of *Apenteles machaeralis*, a background parasite of teak caterpillar *Hapalia machaeralis***. Allehabad University Studies (Zoology Series) 15: 26p.

3142 Chatterjee, P.N. 1951. **The A.B.C. of the problem of biological control of teak defoliators**. Madras Forest College Magazine: 127-132.

Serious defoliation by *Hapalia machaeralis* and *Hyblaea puera* occurs during the post monsoon and pre-monsoon periods respectively every year in the teak plantations. This paper gives briefly the information on the biological control complex of teak defoliators. Host-parasite relations, alternative hosts, parasite-predators, requirements of food, shelter, resting etc. are touched generally. A list of the desirable plants indexed according to parasite value is also included. Mention is made of the liberation of *Cedria paradoxa*.

3143 Choudhury, J.C.B; Misra, M.P. 1981. ***Chaenus rayotus* Bates (Coleoptera: Carabidae: Chlaeniini) - a new predator of *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidae) from Walayar Reserve Forests, Kerala State**. Indian Forester 107(1): 63-65.

Defoliation of teak by *H. puera* was effectively checked by this predator in association with the tachinid *Sturmia inconspicuella*, a potential for biological control is suggested.

3144 Forest Department, Burma. 1949. ***Nemeritis tectonae*, parasite of *Xyleutes ceramica*, the beehole borer of teak**. Report of Working Plans Silvicultural Entomology, Forest Department, Burma 1940-1: 85-86.

The relationship between stem girth of the tree and parasitism of the beehole borer was confirmed, graphs showing this to be inverse. In some areas the rate of parasitism in 2- and 3-year-old shoots on the top branches is as much as 90 percent falling towards the main stem where it sinks to 10-15 percent .

3145 Garthwaite, P.F; Desai, M.H. 1939. **On the biology of the parasites of the teak defoliators, *Hapalia machaeralis* Walk. (Pyralidae) and *Hyblaea puera* Cram. (Hyblaeidae) in Burma**. Indian Forest Records (n.s.) Entomology 5: 309-353.

One hundred and sixteen species of parasites bred out of material of these two insects are dealt with, of these 47 species are primary parasites of *Hapalia machaeralis* and 29 species are primary on *Hyblaea puera*, 11 species being common to both. The method of breeding *Apanteles machaeralis* in the insectary is described.

3146 Gotoh, T; Yincharoen, S; Eungwijarnpanya, S; Hutacharern, C. 2002. **Strategies for the management of the teak beehole borer, *Xyleutes ceramicus* (Walker) (Lepidoptera: Cossidae) in Thailand**. Proceedings of the IUFRO FAO Workshop on Pest Management in Tropical Forest Plantations, Chanthaburi, Thailand, 25-29 May 1998. C. Hutacharen; B. Napompeth; G. Allard; F.R. Wylie, Eds. FORSPA-Publication 30: 99-103. FAO Regional Office for Asia and the Pacific, Bangkok.

The ecology of the teak beehole borer, *Xyleutes ceramicus*, which was studied in northern Thailand. Natural regulation mechanisms were clarified through life table construction. Key factor analysis showed that predation by ants during the egg and the 2nd to 3rd larval stages governs the population changes of the borer.

3147 Intachat, J; Mastura, M; Staines, H. 2000. **Evaluation on the toxicity effect of four *Bacillus thuringiensis* strains against the teak skeletoniser, *Paliga damastesalis* Walker (Lepidoptera: Pyraloidea: Crambidae)**. Journal of Tropical Forest Science 12(3): 425-430.

Four *Bacillus thuringiensis* strains namely: HD-1, Florbac, SN-2 and SN-5, were screened against the 3rd instar of the teak skeletonizer, *Paliga damastesalis*. Bt subspecies aizawai (strain SN-2) was found to be the most effective in controlling the teak skeletonizer larvae.

3148 Intachat, J; Mastura, M; Staines, H. 2000. **The effectiveness of two commercial formulations and SN-2 strain of *Bacillus thuringiensis* against the teak skeletoniser, *Paliga damastesalis***. Journal of Tropical Forest Science 12(4): 804-806.

The effectiveness of a radiation-resistant strain of *Bacillus thuringiensis*, SN-2 strain, was compared with that of 2 commercial formulations after exposure of 125 teak skelotoniser larvae. The mean percentage mortality for SN-2 was approximately twice that for both commercial formulations. The increased effectiveness, sustained over time, and quicker response of SN-2 over current *B. thuringiensis* formulations make this an attractive approach to controlling the teak skeletonizer.

3149 Kalia, S; Harsh, N.S.K; Joshi, K.C. 1998. **Pathogenic fungus of *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidae) a major pest of *Tectona grandis***. Indian Forester 124(8): 671-672.

Two fungal species, *Aspergillus flavus* and *A. niger*, were isolated from dead and moribund larvae of *Hyblaea puera* on teak. Tests of pathogenicity of the fungi showed that only *A. flavus* was pathogenic.

3150 Kalia, S; Harsh, N.S.K. 2003. ***Metarhizium anisopliae* (Metschnikoff) Sorokin pathogenic to the larvae of teak defoliator, *Hyblaea puera* Cramer**. Journal of Entomological Research 27(2): 135-136.

Metarhizium anisopliae was isolated from the larval instars of the teak defoliator, *H. puera*. The fungus exhibited pathogenicity to larval instars of teak defoliator in the laboratory.

3151 Kalia, S; Lall, R.B; Kalia, S. 2000. **Efficacy of three varietal toxins of *Bacillus thuringiensis* tested against some important forest insect pests of multipurpose forest tree species**. Indian Forester 126(1): 62-66.

The effectiveness of 3 varietal toxins of *Bacillus thuringiensis* var. thuringiensis and 2 products of var. *kurstaki*, LDC and Dipel were tested against 10 important insect pests of forest trees. The results indicate that all the defoliators are highly susceptible to the microbial pesticide *B. thuringiensis*, and that spraying the pesticide at 1.5 percent concentration was the most effective in controlling the pests irrespective of the toxin preparations used.

3152 Kalia, S; Pant, N.C. 1999. **Susceptibility of larvae of *Eutectona machaeralis* to two varietal toxins of *Bacillus thuringiensis***. Journal of Tropical Forest Science 11(3): 570-573.

Experiments were laid out to test the efficacy of toxins of *Bacillus thuringiensis* from 2 varieties against the teak leaf skeletoniser, *Eutectona machaeralis*. The pest showed high susceptibility to both toxins, but was more susceptible to that of *B. thuringiensis* sub sp. *dendrolimus*.

3153 Kalshoven, L.G.E. 1960. **Observations on the parasites of *Xyleborus* (twig borers) in Java**. Entomologische Berichten, Amsterdam 20(12): 259-262.

Describes observations on a chalcid of the genus *Tetrastichus* attacking *Xyleborus morigerus* in teak and also *Xyleborus morstatti* and another parasite, presumed to belong to the Proctotrypoidea.

3154 Khan, A.H; Chatterjee, P.N. 1944. **Undergrowth in teak plantations as a factor in reducing defoliation**. Indian Forester 70(11): 365-369.

The chief factors controlling the teak defoliators, *Hyblaea puera* and *Hapalia machaeralis* have been found to be climate and parasitic and predaceous insects. The main object of the study reported in this paper was to determine the relative effectiveness of parasitism of teak defoliators.

3155 Kijker, S. 2001. **Timber plantation development in Thailand**. Proceedings of the International Conference on Timber Plantation Development, Manila, Philippines, 7-9 November 2000: 263-273. Department of Environment and Natural Resources, Quezon City, Philippines.

3156 Kulkarni, N; Joshi, K.C; Gupta, B.N. 1997. **Antifeedant property of *Lantana camara* var. *aculeata* and *Aloe vera* leaves against teak skeletonizer, *Eutectona machaeralis* Walk. (Lepidoptera: Pyralidae)**. Entomon 22(1): 61-65.

Methanolic leaf extracts of two plants *Aloe vera* and *Lantana camara* var. *aculeata* were screened for antifeedant properties against *Eutectona machaeralis* at various concentrations. Extracts of both plants were equally effective in reducing the food consumption rate.

3157 Livingstone, D; Yacoob, M.H.S; Bai, S.J. 1982. **A report on *Erythmelus empoascae*, a Mymarid egg parasite of the teak tingid *Pontanus puerilis* Drake & Poor (Heteroptera: Tingidae)**. Journal of the Indian Academy of Wood Science 13(1): 27-29.

The parasite/host relationship of *E. empoascae*/*P. puerilis* is recorded here for the first time. Brief information is given on the nature of the parasitization, infestation and distribution of the parasite in South India.

3158 Loganathan, J; David, P.M.M. 1999. **Natural parasitism in teak defoliator, *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidae) in intensively managed plantation**. Journal of Biological Control 13(1/2): 115-120.

Parasitism in teak defoliator, *Hyblaea puera* was studied in an intensively managed teak plantation in Tamil Nadu. Parasitism by *P. solennis* suppressed the defoliator larval population in the fourth generation.

3159 Loganathan, J; David, P.M.M. 1999. **Predator complex of the teak defoliator, *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidae) in an intensively managed teak plantation at Veeravanallur, Tamil Nadu**. Entomon 24(3): 259-263.

A detailed survey was made in a 3-year-old intensively managed teak plantation to understand the predator complex of defoliator, *Hyblaea puera*. Seventeen species of spiders, five species of carabids, four species of bugs and eight species of birds were identified as predators on defoliators.

3160 Loganathan, J; David, P.M.M. 1999. **Sticky weeds as an understorey vegetation in intensively managed teak plantation for defoliator management**. Crop Protection 18(9): 577-580.

In an intensively managed commercial teak plantation in Tamil Nadu wild undergrowth of two malvaceous weed species, namely, *Pavonia odorata* and *Pavonia zeylanica* trapped larvae of the teak defoliator, *Hyblaea puera*. Artificial introduction of defoliator larvae on these 'bio-trap plants' showed arrested movement of larvae with over 80 percent mortality of first and second instar one day after release.

3161 Loganathan, J; David, P.M.M. 2000. **Laboratory and field evaluation of *Bacillus thuringiensis* Berliner products against the teak defoliator, *Hyblaea puera* Cramer**. Insect Science and its Application 20(1): 61-65.

Commercial *Bacillus thuringiensis* Berliner products, namely Delfin R, Agree R, Halt R and Spicturin R were evaluated in the laboratory and on an intensively managed teak plantation in Tamil Nadu for the control of the teak defoliator, *Hyblaea puera*. A 2 g/litre concentration showed highly significant lethality against defoliator larvae.

3162 Mathew, G. 2003. **Feasibility of biological control of forest insect pests - An assessment with teak defoliator management as an example**. Biological control of insect pests: 127-131. S. Ignasimuthu; S. Jayaraj, Eds. Phoenix Publishing House, Delhi.

Biological control of insect pests is the most acceptable form of pest management in forest ecosystems. For successful management, a critical evaluation of various aspects such as the tolerable injury level of the plant, the value of the crop, nature of the pest damage and cost involved, etc, are to be considered. The scope of the biological control of the pest is discussed.

3163 Mathew, G; Ali, M.I.M. 1987. **Microbial pathogens causing mortality in the carpenterworm, *Cossus cadambae* Moore (Lepidoptera, Cossidae), a pest of teak (*Tectona grandis* Linn.f.) in Kerala (India)**. Journal of Tropical Forestry 3(4): 349-351.

Six species of pathogenic organisms were isolated and identified from field and laboratory specimens of C. cadambae: Aspergillus flavus, Paecilomyces fumosoroseus, Serratia marcescens, Pseudomonas sp., Penicillium citrinum and Fusarium solani.

3164 Mathur, R.N. 1977. **Integrated pest control in forestry**. Indian Forester 103(9): 585-591.

The importance is emphasized of knowing the ecology and dynamics of insect populations before undertaking control measures. Insect attack on important Indian tree species, e.g. the defoliators, *Hapalia machaeralis* and *Hyblaea puera* on teak, are used to illustrate the integrated use of silvicultural, biological and chemical control methods.

3165 Meshram, P.B; Bisaria, A.K; Kalia, S. 1997. **Efficacy of Bioasp and Biolep - a microbial insecticide against teak skeletonizer, *Eutec-***

***tona machaeralis* Walk**. Indian Forester 123(12): 1202-1204.

Two commercial formulations, viz. Bioasp and Biolep of *Bacillus thuringiensis* var. *kurstaki* were tested against *E. machaeralis*. All treatments gave significantly better larval mortality than the control. Bioasp 2 percent was most effective giving 85.9 percent mortality followed by Biolep.

3166 Misra, R.M. 1975. **Note on *Anthia sexguttata* Fabricius (Carabidae: Coleoptera), a new predator of *Pyrausta machaeralis* Walker and *Hyblaea puera* Cramer**. Indian Forester 101(10): p605.

During a survey of the natural enemies of defoliating pests in teak plantations adults of the carabid *Anthia sexguttata* were observed preying on fourth-instar larvae of *Pyrausta machaeralis*. The prey-capturing and feeding habits of *A. sexguttata* are described.

3167 Mohanadas, K. 1996. **New records of some natural enemies of the teak defoliator, *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidae) from Kerala, India**. Entomon 21(3/4): 251-253.

Six species of hymenopteran parasitoids, Camptotypus arianus, Xanthopimpla sp., Theronia maskeliyae, Psilochalcis carinigena, Brachymeria lugubris and Tetrastichus howardi and 4 species of reduviid predators, Euagoras plagiatus, Endochus sp., Rhenocoris fuscipes and Sphedanolestus aterrimus were recorded for the first time from Hyblaea puera.

3168 Nair, K.S.S. 1998. **KFRI's tryst with the teak defoliator**. Evergreen 40: 1-7. Kerala Forest Research Institute, Peechi.

A short report is given of research at the Kerala Forest Research Institute on the teak defoliator, *Hyblaea puera*. The report covers the impact of defoliation on volume increment, population dynamics, the search for resistant trees, an artificial diet for mass rearing, a solar light trap for population monitoring, and biological control using parasites, baculovirus and commercial formulations of *Bacillus thuringiensis*. Future prospects for control are briefly discussed.

3169 Nair, K.S.S; Babjan, B; Sajeev, T.V; Sudheendrakumar, V.V; Ali, M.I.M; Varma, R.V; Mohanadas, K. 1996. **Field efficacy of nuclear polyhedrosis virus for protection of teak against the defoliator, *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidae)**. Journal of Biological Control 10(1/2): 79-85.

A teak plantation at Nilambur, Kerala, was protected from *Hyblaea puera* using a naturally occurring baculovirus. A single foliar application of a crude preparation of HpNPV at the rate of 1 X 105 PIBs ml-1 of spray fluid at the earliest sign of each infestation gave a 70-76 percent level of control. In protected trees, the basal area increment was enhanced by 41 percent, indicating the efficacy of HpNPV as a biocontrol agent.

3170 Nair, K.S.S; Mohanadas, K; Sudheendrakumar, V.V. 1997. **Biological control of the teak defoliator, *Hyblaea puera* Cramer (Lepidoptera, Hyblaeidae) using insect parasitoids - problems and prospects**. Biological Control of Social Forest and Plantation Crop Insect: 75-95. T.N. Ananthakrishnan, Ed. Oxford and IBH, New Delhi.

Information on the parasitoids of *H. puera* in India are summarized and based on original data on pest and parasitoid populations and their dynamics in teak plantations at Nilambur, Kerala, the potential of each group of parasitoids for biological control is evaluated. It is shown that well timed inundative release of selected parasitoids control the pest.

3171 Nair, K.S.S; Sudheendrakumar, V.V; Mohanadas, K; Varma, R.V. 1997. **Control of the teak defoliator - past attempts and the new promise**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 81-83. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

This paper summarises past attempts for the control, evaluates the accomplishments and constraints and contemplates on future prospects.

3172 Nair, K.S.S; Varma, R.V; Sudheendrakumar, V.V; Mohanadas, K; Ali, M.I.M. 1998. **Management of the teak defoliator (*Hyblaea puera*) using nuclear polyhedrosis virus (NPV)**. KFRI Research Report 151: 64p. Kerala Forest Research Institute, Peechi.

Evaluated the usefulness of a naturally occurring nuclear polyhedrosis virus of the teak defoliator, *Hyblaea puera* and developed suitable field application methods. A unique mass production method was developed for HpNPV, which made use of the availability of large numbers of larvae during natural pest outbreaks in teak plantations. Laboratory methods of HpNPV production were also developed using artificially reared larvae. Methods were standardized for timely application of HpNPV using a pest monitoring system involving moth catches with a solar powered light trap.

3173 Nair, K.S.S; Varma, R.V; Sudheendrakumar, V.V; Mohandas, K; Sajeev, T.V. 2001. **Use of baculovirus control agents within an integrated pest management strategy against teak defoliator, *Hyblaea puera*, in India**. KFRI Research Report 203: 51p. Kerala Forest Research Institute, Peechi.

The study was to use the *Hyblaea puera* nuclear polyhedrosis virus economically and effectively for controlling the teak defoliator. The optimal use of the virus was examined considering various parameters. The information quantified included aspects of virus-host interaction, virus production methods, virus yield and the effect of environmental factors like ultra violet light and rainfall on virus persistence. The efficiency of different spraying systems was also evaluated based on the quantified information on droplet emission and field capture rates. The study revealed the scope of using HpNPV in the most efficient way against *H. puera*, by considering various parameters with the Control Window concept.

3174 Patil, B.V; Thontadarya, T.S. 1983. **Natural enemy complex of the teak skeletonizer, *Pyrausta machaeralis* Walker (Lepidoptera: Pyralidae) in Karnataka**. Entomon 8(3): 249-255.

A survey conducted in forests in Karnataka on the natural enemies of the teak pest, *Pyrausta machaeralis* revealed the presence of 43 species of parasites, 60 species of predators, 3 species of pathogens and 8 species of hyperparasites.

3175 Patil, B.V; Thontadarya, T.S. 1983. **Studies on the acceptance and biology of different *Trichogramma* spp. on the teak skeletonizer, *Pyrausta machaeralis* Walker**. Indian Forester 109(5): 292-297.

All 10 species of *Trichogramma* parasites tested in the laboratory successfully completed their development in eggs of P. machaeralis.

3176 Patil, B.V; Thontadarya, T.S. 1984. **Efficacy of egg parasite, *Trichogramma* spp. in parasitising the eggs of the teak skeletonizer, *Pyrausta machaeralis* Walker (Lepidoptera: Pyralidae)**. Indian Forester 110(4): 413-418.

Three species of exotic parasites, *Trichogramma* were released in a moderately infested 3-yr-old teak plantation to study their possible establishment and survival capacity in parasitizing the eggs of P. machaeralis. Recoveries of parasitized eggs were quite high after two and seven days of release in all three species. The study indicated the possibility of success if the three *Trichogramma* species were released in large numbers.

3177 Patil, B.V; Thontadarya, T.S. 1986. **Diapause in teak skeletonizer, *Pyrausta machaeralis* and its parasite, *Cremnops atricornis***. Mysore Journal of Agricultural Sciences 20(1): 38-42.

The diapaused larvae of *E. machaeralis* were parasitized by the braconid *Cremnops atricornis* which underwent larval diapause in synchrony with the host.

3178 Patil, S.U; Naik, M.I. 1997. **Evaluation of *Trichogramma* chilonis Ishii-An egg parasitoid against teak defoliator, *Hyblaea puera* Cramer**. Indian Journal of Forestry 20(2): 183-186.

Parasitoids, *Trichogramma chilonis* were released at different dosages into 10-yr-old teak plantations infested by *Hyblaea puera*. Significant variations in the egg populations and in the larval population were found among treatments, and a high percentage of parasitism was found both in eggs and larvae of *H. puera*. Parasitization increased, and larval populations of *H. puera* decreased as the dosage of *T. chilonis* per acre was increased.

3179 Patil, S.U; Naik, M.I. 1998. **Natural enemies of teak defoliator, *Hyblaea puera* Cramer and their seasonal incidence**. Indian Journal of Forestry 21(3): 253-255.

Surveys were made of natural enemies of *Hyblaea puera* during the period of the pest's activity in teak plantations. Some 11 larval parasitoids and 4 predators of *H. puera* were identified. *Elachertus nigrithorax*, *Eriborus* sp. and *Nitala* sp. were recorded for the first time on *H. puera*. The parasitoids *Palexorista solennis, Eriborus* sp., *Apanteles* sp., *Goniozus* sp., *Mesochorus* sp. and *Elachertus nigrithorax* were more efficient at suppressing the population of *H. puera* in the teak plantations.

3180 Pillai, S.R.M; Gopi, K.C. 1996. **Stem gall of teak and its management**. Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium, Peechi, 23-26

November 1993: 427-430. K.S.S. Nair; J.K. Sharma; R.V. Varma, Eds. Kerala Forest Research Institute, Peechi.

Occurrence of gall midge, *Asphondylia tectonae*, attack in the South Indian teak growing region is explored. Possible damage inflicted is discussed with special reference to a new parasitoid *Syntomernus* sp. as a biological control agent.

3181 Rabindra, R.J; Varma, R.V; Ali, M.I.M; Sudheendrakumar, V.V. 1997. **Tests for cross-infectivity of the nuclear polyhedrosis virus of the teak defoliator, *Hyblaea puera* to some lepidopterous insects**. Pest Management in Horticultural Ecosystems 3(2): 109-111.

Studies with the nuclear polyhedrosis virus of *Hyblaea puera* showed that it was not cross-infective to larvae of *Helicoverpa armigera, Spodoptera litura* or *Amsacta albistriga*.

3182 Sajeev, T.V; Nair, K.S.S; Varma, R.V; Sudheendrakumar, V.V; Ali, M.I.M; Mohanadas, K. 2001. **Use of nuclear polyhedrosis virus against the teak defoliator, *Hyblaea puera*: Problems and prospects**. Microbials in Insect Pest Management: 149-153. Scientific Publishers, USA.

3183 Sakchoowong, W. 2002 . **Effects of entomopathogenic fungi on teak defoliator, *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidae) in laboratory**. Proceedings of the IUFRO FAO Workshop on Pest Management in Tropical Forest Plantations, Chanthaburi, Thailand, 25-29 May 1998. C. Hutacharen; B. Napompeth; G. Allard; F.R. Wylie, Eds. FORSPA Publication 30: 105-110. FAO Regional Office for Asia and the Pacific, Bangkok.

Studies on the effects of entomopathogenic fungi, *Beauveria bassiana* and *Metarhizium anisopliae* on *Hyblaea puera* was carried out in the laboratory to test their virulence and comparative efficiency for control. The results showed that both B. bassiana and *M. anisopliae* were pathogenic to the *H. puera* larvae.

3184 Sandhu, S.S; Rajak, R.C; Agarwal, G.P. 1993 . **Microbial control agents of forest pests at Jabalpur**. Annals of Forestry 1(2): 136-140.

Periodical surveys of infected, mummified and colonized insect larvae on forest trees have resulted in the isolation of various entomopathogenic microorganisms. Seven fungi, one bacterium, one unidentified virus and one nematode were isolated from larvae of forest insect pests. Their pathogenicity was evaluated under laboratory conditions.

3185 Sankaran, K.V; Mohanadas, K; Ali, M.I.M. 1989. ***Beauveria bassiana* (Bals.) Vuill., a possible biocontrol agent against *Myllocerus viridanus* Fabr. and *Calopepla leayana* Latreille in South India**. Current Science 58(8): 467-469.

The fungal pathogen *Beauveria bassiana* is reported causing mortality in the chrysomelid, *Myllocerus viridanus* on teak in Kerala. In the laboratory, sprays containing spores applied caused 53 and 43 percent mortality.

3186 Sivaramakrishnan, V.R. 1976. **Occurrence of Lantana lace bug, *Teleonemia scrupulosa* Stal (Hemiptera: Tingidae) in South India**. Indian Forester 102(9): 620-621.

T. scrupulosa introduced into India from Australia and has been found infesting *Lantana* spp. The bugs feed on the leaves, inflorescence and fruits of Lantana spp. causing a burnt appearance. It is suggested that *T. scrupulosa* be used to suppress growth of the weed in sandal forests where no teak is grown.

3187 Sudheendrakumar, V.V. 1985. **Studies on the parasites of *Hyblaea puera* in teak plantations at Nilambur**. Advances in Biological Control in India. Proceedings of the National Seminar on Entomology, Calicut: 116-122. K.J. Joseph; U.C. Abdurahiman, Eds. University of Calicut.

Five species of parasites of *Hyblaea puera* namely, *Palexorista solennis, Brachymeria lasus, Sympiesis* sp. and two species of unidentified ichneumonid wasps were recorded. Among these parasites *Sympiesis* sp. is a new record on *H. puera*.

3188 Sudheendrakumar, V.V. 1993. **Notes on hymenopteran parasites of *Eutectona machaeralis* recorded from Nilambur, Kerala**. Indian Forester 119(6): 510-511.

Brief descriptions are given of 6 species of parasitoids of *Eutectona machaeralis* recorded in teak plantations. The parasites were *Trathala hapaliae*, *Gotra* sp. and *Stictopistus* sp., *Apanteles ruidis*, *Phanerotoma hendecasiella* and *Brachymeria hime attevae*.

3189 Sudheendrakumar, V.V. 1997. **Evaluation of parasitoids for biological control of the teak defoliator**. KFRI Research Report 129: 32p. Kerala Forest Research Institute, Peechi.

The biology, behaviour and mass multiplication of two species of indigenous parasitoids of the teak defoliator, *Hyblaea puera* namely, *Sympiesis hyblaeae* and *Palexorista solennis* were studied and the usefulness of these parasitoids as candidates for the biological control programme was evaluated based on their biological characteristics.

3190 Sudheendrakumar, V.V; Evans, H.F; Varma, R.V; Sajeev, T.V; Mohanadas, K; Sathyakumar, K.V. 2001. **Management of the teak defoliator, *Hyblaea puera* using baculovirus within a control window concept**. Tropical Forestry Research: Challenges in the New Millennium. Proceedings of the International Symposium, Peechi, India, 2-4 August 2000. R.V. Varma; K.V. Bhat; E.M. Muralidharan; J.K. Sharma, Eds: 106-114. Kerala Forest Research Institute, Peechi.

The paper deals with a comprehensive approach for using HpNPV for the management of the teak defoliator. The pest management, based on the Control Window concept, concentrates on five primary variables, the host, *Hyblaea puera*, the virus, environmental factors, the host tree, teak and spray technology. Under virus biology, dosage-mortality relationship between the virus and host and effect of environmental factors such as ultraviolet light, rain, etc., on virus persistence were studied.

3191 Sudheendrakumar, V.V; Sajeev, T.V; Varma, R.V. 2001. **Teak defoliator management by controlling epicentre populations - a case study**. KFRI Research Report 219: 31p. Kerala Forest Research Institute, Peechi.

A study was carried out to test the impact of controlling epicentre populations of the teak defoliator, *Hyblaea puera* on further large scale outbreaks. Sixteen epicentre patches area were detected between late February and late March and successfully controlled.

3192 Sudheendrakumar, V.V. 2002. **Bioecology of *Sympiesis hyblaeae* Surekha (Hymenoptera: Eulophidae) a parasitoid of the teak defoliator, *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidae)**. Journal of Biological Control 16(2): 97-101.

The biology, behviour and seasonal dynamics of *Sympiesis hyblaeae* an ectoparasitoid of the teak defoliator, *Hyblaea puera* are discussed. Pupae are observed going through a diapause period ranging from 111-156 days. The seasonal incidence pattern indicates that *S. hyblaeae* is not a potential natural biocontrol agent of the teak defoliator.

3193 Sudheendrakumar, V.V. 2002 . **Feasibility of using indigenous parasitoids for biological control of the teak defoliator, *Hyblaea puera* (Lepidoptera: Hyblaeidae)**. Proceedings of the IUFRO FAO Workshop on Pest Management in Tropical Forest Plantations, Chanthaburi, Thailand, 25-29 May 1998. C. Hutacharen; B. Napompeth; G. Allard; F.R. Wylie, Eds. FORSPA Publication 30: 111-121. FAO Regional Office for Asia and the Pacific, Bangkok.

This paper deals with the scope and limitations of using indigenous parasitoids for practical biological control of *Hyblaea puera*. The potential of two larval parasitoids, *Sympiesis hyblaeae* and *Palexorista solennis* were studied and evaluated based on their biological and behavioural characteristics and the feasibility of mass multiplication. The study revealed that mass multiplication of *P. solennis* is feasible under laboratory condition as per standard methods.

3194 Surekha, K; LaSalle, J; Sudheendrakumar, V.V; Murphy, S.T. 1996. **A new species of *Sympiesis* (Hymenoptera: Eulophidae) parasitic on the teak defoliator *Hyblaea puera* (Lepidoptera: Hyblaeidae) in India**. Bulletin of Entomological Research 86(1): 73-76.

Sympiesis hyblaeae, which is a solitary endoparasitoid of first- and second-instar larvae, is a potential biological control agent of the teak defoliator, *Hyblaea puera*.

3195 Tilakaratna, D. 1991. **Parasites of the teak defoliator, *Hyblaea puera***. Sri Lanka Forester 20(1/2): 23-25.

This paper gives brief accounts of three species of insect parasites which may be useful for the control of teak defoliators. They are *Brachymeria euploeae, Echthromorpha notularia* and *Carcelia kockiana*.

3196 Wiwatwitaya, D. 1996. **Predator ants of teak beehole borer, *Xyleutes ceramicus* Walker (Lepidoptera: Cossidae)**. (Thai). Kasetsart Journal, Natural Sciences 30(3): 330-335.

The study on predator ants of teak beehole borer, *Xyleutes ceramicus* was carried out with the purpose to investigate the quantity and kind of predatory ant species preying on the borer. *Crematogaster* spp. and *A. longipes* were mostly dominant predators on the borer.

3197 Zacharias, V.J; Mohanadas, K. 1990. **Bird predators of the teak defoliator *Hyblaea puera***. Indian Journal of Forestry 13(2): 122-127.

Out of 58 species of birds observed in the older plantation, 48 were feeding on *Hyblaea puera*. In the younger plantation 44 bird species were observed and 41 were feeding on *H. puera*. Data are tabulated of birds seen feeding on larvae, or observed feeding on larvae throughout the observation periods and birds suspected to feed on pupae.

Go top

Chemical Control

3198 Bandara, G.D. 1990. **Chemical control of cockchafer grub (Holotrichia serrata) in teak nurseries**. Sri Lanka Forester 19(3/4): 47-50.

The damage caused by the cockchafer grub, larvae of *Holotrichia serrata* in nurseries is one of the main problems in raising teak plantations. In this study three insecticides, carbofuran, diazinon, and benfuracarb, were tested against the pest and carbofuran is found to be the best insecticide for controlling this pest.

3199 Borse, S.S; Thakur, M.L. 1993. **Relative toxicity of some synthetic pyrethroids against teak skeletonizer, *Eutectona machaeralis* (Walk.) (Lepidoptera: Pyralidae)**. Indian Journal of Forestry 16(3): 193-195.

The results are presented of laboratory experiments with commercial formulations of three commonly available pyrethroid insecticides tested against third instar larvae of the teak skeletonizer, *Eutectona machaeralis*.

3200 Borse, S.S; Thakur, M.L. 1994. **Residual toxicity of some commercial synthetic pyrethroids to *Eutectona machaeralis* (Walk.) (Lepidoptera: Pyralidae)**. Indian Journal of Forestry 17(1): 49-52.

Cypermethrin, deltamethrin and fenvalerate were evaluated for their residual toxicity against the teak skeletonizer, *E. machaeralis* under laboratory conditions using sprayed potted 1-month-old seedlings of teak. Cypermethrin showed significantly higher residual toxicity to *E. machaeralis* than those of deltamethrin and fenvalerate.

3201 Choudhury, J.C.B. 1971. **Interim report on the Konni aerial spraying project**. Working Plan for Nilambur Forest Division, 1967-68 to 1976-77: 165-168: K.G. Vasudevan, Ed. Government of Kerala.

3202 David, B.V; Manickavasagam, S. 1996. **Use of chitin inhibitor, diflubenzuron in forest insect pest management**. Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium, Peechi, India, 23-26 November 1993: 382-383. K.S.S. Nair; J.K. Sharma; R.V. Varma, Eds. Kerala Forest Research Institute, Peechi, India.

Environment friendly pesticides like the chitin synthesis inhibitor, diflubenzuron, are ideal for forest pest management. Results of studies indicate that diflubenzuron is effective against the lepidopteran defoliators of teak, poplar and chir pine.

3203 Eungwijarnpanya, S; Yincharoen, S. 2002. **Control of teak defoliator, *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidae), by thermal fogger application of neem extract**. Proceedings of the IUFRO FAO Workshop on Pest Management in Tropical Forest Plantations, Chanthaburi, Thailand, 25-29 May 1998. C. Hutacharen; B. Napompeth; G. Allard; F.R. Wylie, Eds. FORSPA Publication 30: 123-125. FAO Regional Office for Asia and the Pacific, Bangkok.

Neem extract containing 0.185 percent azadirachtin was tested at three concentrations diluted in 5 litres of water applied to a teak plantation in Lampang province, Thailand to test for control of *Hyblaea puera*.

3204 Gu, M.B. 1982. **A discussion on the problem of controlling *Pyrausta machaeralis***. Acta Entomologica Sinica 25(1): p8.

The author discusses the problems encountered in the insecticidal control of *Eutectona machaeralis* on *Tectona grandis* in China.

3205 Gupta, B.K; Borse, S.S. 1997. **Relative toxicity of some insecticides as contact poison against third instar larvae of *Hyblaea puera* (Lepidoptera: Hyblaeidae)**. Indian Forester 123(5): 427-429.

Eleven insecticides were bioassayed against third instar larvae of *Hyblaea puera* under laboratory conditions. Their relative toxicity was assessed.

3206 Gupta, B.K; Sen Sarma, P.K. 1978. **Antitermite properties of some anthraquinone derivatives**. Holzforschung und Holzverwertung 30(3): 57-58.

During laboratory tests 6 anthraquinone derivatives were tested against

Neotermes bosei and *Microcerotermes beesoni* . Of the 6 derivatives, chrysophanol proved most resistant to the termites.

3207 Intari, S.E; Amir, M. 1975. **Observations on attack by *Neotermes tectonae* on teak in Mantingan forest district, central Java, and a trial of chemical control with Phostoxine**. Laporan, Lembaga Penelitian Hutan 198: 18p.

Describes the damage caused by this pest and discusses its control and the influence of stand age and microclimate. Chemical control was tried on *Tectona grandis* by introducing a fumigant tablet through a small hole drilled in the stem.

3208 Mathew, G. 1993. **Injection and implantation of some systematic insecticides for the control of the teak carpenterworm, *Alcterogystia cadambae* (Moore) (Lepidoptera: Cossidae)**. Journal of Tropical Forestry 9(2): 148-151.

The effectiveness of bole injected chemicals for the control of the teak carpenter worm, *Alcterogystia cadambae* was field tested. High dosages of dimethoate, phosphamidon, monocrotophos and acephate were used in the trials.

3209 Meshram, P.B. 1995. **Evaluation of some medicinal and natural plant extracts against teak skeletonizer, *Eutectona machaeralis* Walk**. Indian Forester 121(6): 528-532.

Crude extract of fresh leaves of 32 different medicinal and other woody plants were tested under laboratory against third instar larvae of the teak skeletonizer, *Eutectona machaeralis* to evaluate their antifeedant and insecticidal effects.

3210 Meshram, P.B; Joshi, K.C; Sarkar, A.K. 1993. **Efficacy of some insecticides against the white grub, *Holotrichia insularis* Brenske in teak nursery**. Annals of Forestry 1(2): 196-198.

Six insecticides, phorate, aldrin and Folidal were tested for their effects on white grub populations and grub damage of teak seedlings in a nursery in Maharashtra.

3211 Meshram, P.B; Kulkarni, N; Joshi, K.C. 1994. **Antifeedant activity of certain plant products against teak skeletonizer, *Eutectona machaeralis* Walk. (Lepidoptera: Pyralidae)**. Annals of Entomology 12(2): 53-56.

Extracts of *Azadirachta indica*, *Aloe vera*, *Jatropha curcas*, *Calotropis procera*, *Annona squamosa* and *Vitex negundo* were tested for their antifeedant properties against third-instar larvae of *Eutectona machaeralis* in the laboratory.

3212 Meshram, P.B; Pathak, S.C; Jamaluddin. 1990. **Effect of some soil insecticides in controlling the major insect pests in teak nursery**. Indian Forester 116(3): 206-213.

The results are reported of a field experiment in the teak nursery in Madhya Pradesh on control of the three major nursery pests of the species: white root grubs, teak defoliator and teak skeletonizer. insecticides were applied on seed beds and at the seedling stage. Carbaryl and HCH were found the most effective treatments against these pests.

3213 Muttiah, S. 1967. **An insecticide trial for the control of cockchafer larvae (*Anomala* sp.) in teak nurseries**. Ceylon Forester 8(1/20): 12-19.

Experiments in spraying teak seed beds after germination with Sevin, Gammexane, Endrex and Aldrex 2, to control damage by chafer grubs, indicated the significant superiority of Sevin.

3214 Nair, K.S.S. 1986. **The problem of insect defoliation of teak - to spray or not to spray**. Proceedings of the 2nd Forestry Conference Vol.2: 876-879. Forest Research Institute and Colleges, Dehra Dun.

A critical review of past attempts to estimate loss of wood increment due to defoliation shows that no reliable estimate is available. A realistic appraisal of the damage in economic terms is essential before attempting control measures. The need for detailed investigations on the nature and cause of fluctuations in the populations of the defoliator complex is stressed to decide on the best pest management strategy.

3215 Nair, K.S.S. 1987. **Control of the sapling borer, *Sahyadrassus malabaricus* (Lepidoptera, Hepialidae) in forest plantations**. Entomon 12(2): 137-139.

Five insecticides were tested for the control of larvae of *Sahyadrassus malabaricus* in plantations of teak and *Trema orientalis* in Kerala. HCH, lindane, carbaryl, Sevimol and tar concentrate did not give complete protection. Quinalphos gave complete control.

3216 Neelay, V.R; Bhandari, R.S; Negi, K.S. 1983. **Effect of insecticidal and hormonal spray on the production of fruits in teak seed orchard**. Indian Forester 109(11): 829-839.

The problem of poor seed setting in a seed orchard in Maharashtra was investigated. Major insect pests causing fruit loss are Pagyda salvalis, Leptocentrus vicarius, *Dichocrocis punctiferalis*, *Hyblaea puera* and *Eutectona machaeralis*. Insecticides were applied as a spray with the hormone NAA and without the hormone. Data shows that the best results were with nuvacron or endosulfan both as water emulsions with 40 p.p.m. NAA.

3217 Patil, A.K; Patil, B.R; Patil, A.P; Patil, P.T. 1995. **Efficacy of insecticides against the teak defoliator *Hyblaea puera* Cramer (Lepidoptera: Hyblacidae)**. Indian Journal of Forestry 18(4): 290-292.

A field trial was laid out to test the efficacy of seven insecticides, viz. cypermethrin, fenvalerate, monocrotophos, acephate, endosulfan, quinalphos and carbaryl, against this pest. Cypermethrin, fenvalerate and acephate were found highly effective.

3218 Perez, G.C.M. 1947. **Insecticidal value of *Tephrosia noctiflora* and *T. cinerea***. (Spanish). Revista de la Facultad de Ciencias Cuimicas, Universidad Nacional de la Plata 22, 1947: 239-266.

3219 Remadevi, O.K; Muthukrishnan, R. 1998. **Farmer trials on the control of the defoliators, *Eutectona machaeralis* Walker and *Hyblaea puera* Cramer on teak saplings**. Advances in IPM for horticultural crops. Proceedings of the First National Symposium on Pest Management in Horticultural Crops: Environmental implications and thrusts, Bangalore, 15-17 October 1997: 179-182. P.P. Reddy; N.K.K. Kumar; A. Verghese, Eds. Association for Advancement of Pest Management in Horticultural Ecosystems, Indian Institute of Horticultural Research, Bangalore.

A field study in Karnataka revealed that 0.1 percent of monocrotophos was best for immediate control of the pests followed by chlorpyrifos and quinalphos.

3220 Sandermann, W; Schmidt, H. 1973. **The effectiveness of some organic compounds against the soil termite *Reticulitermes flavipes* (Kollar)**. (German). Holz als Roh- und Werkstoff 31(2): 71-73.

The mortality rate of termites in the presence of filter paper soaked in solutions of 16 organic compounds was determined. The results showed that the action of tectoquinone is not specifically related to the structure of organic compounds, but that other compounds with a similar skeleton are more effective.

3221 Senguttuvan, T; Chinniah, C; Varma, R.V; Nair, K.S.S. 2000. **Knockdown toxicity of insecticides and B.T formulations on larvae of teak defoliator, *Hyblaea puera***. Indian Journal of Forestry 23(2): 160-163.

Laboratory experiments were conducted to assess the knockdown toxicity of six insecticides against third and fourth instar larvae of the teak defoliator, *Hyblaea puera*. All the insecticides were highly effective against both third and fourth instar larvae under controlled conditions after 24 h of feeding. The *B. thuringiensis* formulations were effective even at lower concentrations against third instar and at higher concentrations against fourth instar larvae.

3222 Singh, P. 1980. **Aerial spraying of chemicals to control teak defoliators**. Proceedings of the 2nd Forestry Conference Vol.2: 901-907. Forest Research Institute and Colleges, Dehra Dun, India.

3223 Singh, P; Gupta, B.K. 1978. **Laboratory evaluations of insecticides as contact sprays against forest pests. I. Teak skeletoniser: *Pyrausta machaeralis* Walker (Lepidoptera: Pyralidae)**. Indian Forester 104(5): 359-366.

Out of twenty insecticides tested, with 3rd-instar larvae, monocrotophos, chlordimeform, quinalphos and Anthio were found the most effective.

3224 Vaishampayan, S.M; Bhandari, R.S. 1980. **Chemical control of white grubs (*Holotrichia insularis*) in teak nurseries**. Proceedings of the 2nd Forest Conference, Vol.2: 868-872.

3225 Vivekanandan, K. 1975. **Control of cockchafer grub in teak nursery**. Sri Lanka Forester 12(1): 40-43.

Of five insecticides applied fensulfothion granules at the rate of 1.5 lb/160 ft2 gave the most effective control of the larvae of *Holotrichia serrata*.

3226 Wolcott, G.N. 1947. **Termite repellents: A summary of laboratory tests**. Bulletin of Argricultural Experiment station 73. University of Puerto Rico.

3227 Wolcott, G.N. 1954. **Termite damage and control as factors in the utilization of timber in the Caribbean area**. Journal of Agriculture of the University of Puerto Rico 38(2): 115-122.

Biology and destructive ability of *Nasutitermes costalis*, *Heterotermes tenuis* and *Cryptotermes brevis* is studied and out of which the first causes much less economic damage. Chlordane, aldrin and dieldrin are found very efficient in killing the termites and impregnation of susceptible woods with pentachlorophenol or its Na salt prevents attack.

3228 Wolcott, G.N. 1955. **Termite repellents: A summary of laboratory tests**. Journal Agricultural University, Puerto Rico 39: p115.

Go top

Surveying and Mapping

3229 **Report of the result of forest inventory work carried out in N. Thailand**. (Siamese). Vanasarn 16(1), 1958: 16-22.

Results are presented of forest inventory carried out in N. Thailand in 1956.

3230 **Areas of teak plantations in Africa**. Unasylva 21(3/4), 1967.

3231 **Forest plantations in Latin America: Their development and prospects**. Revue forestal venezolona 11(16), 1968: 5-47.

A review give information on the areas of plantations of different species which include teak established since 1965, age, distribution of plantations and the mean area planted annually from 1961 to 1965, and future planting programmes.

3232 Bhatia, K.K. 1954. **Factors in the distribution of teak (*Tectona grandis* Linn.f.) and a survey of teak forests of Madhya Pradesh**. Thesis. Saugar University.

3233 FAO. 2000. **Global forest resources assessment - main report**. FAO Forestry Paper 140. FAO, Rome.

3234 Ferguson, J.H.A. 1933. **Alignment chart to find the number of trees out of the upper height and the degree of thinning**. (Dutch; English). Tectona 26: 763-771.

The article described the general use of alignment chart with appended charts. For any given upper height and mean mutual distance of trees of the upper height, the number of trees per hectare can be read from these charts. By means of a second alignment chart the number of trees per hectare can be reduced to the number of trees in any area.

3235 Forest Department, Trinidad and Tobago. 1988. **Our plantation resource: an inventory of forest plantations in Trinidad**. 89p. Forestry Division, Port of Trinidad and Tobago, Spain.

Tables show the area, relative density, height and stocking of *Tectona grandis* and *Pinus caribaea* plantations in Trinidad and Tobago.

3236 Hamzah, Z. 1975. **Report on a survey of the area of *Tectona grandis* in the province of SE Celebes, forest districts of Kendari, Muna and Buton**. (Indonesian). Laporan, Lembaga Penelitian Hutan 201: 173p.

Many historical references and local traditions concerning the natural stands are reviewed in support of the view that teak is not indigenous to Celebes but was introduced by Hindu migrants from Java. The current neglect of forest management in many areas is emphasized and the drafting of a working plan for the whole province is recommended, especially to safeguard the teak areas.

3237 Hamzah, Z. 1975. **Report on a survey of the area of *Tectona grandis* in the province of Western Lesser Sunda Is., forest district of Lombok**. (Indonesian). Laporan, Lembaga Penelitian Hutan 200: 70p.

This report gives an account of the forests and forestry, geography, soils, etc. as well as tabulated inventories of teak plantations. The properties of wood are equivalent to those of Java teak. It is recommended that secondary forest in the Pelangan peninsula should be converted to teak plantations.

3238 Hamzah, Z. 1975. **Report on a survey of the area of *Tectona grandis* in the province of West Sumatra**. (Indonesian). Laporan, Lembaga Penelitian Hutan 203: 163p.

A detailed account of forestry and forest administration as well as the vegetation, soils, and political geography of this province of Indonesia is given. The local provenance of *T. grandis* appears to be a distinct ecotype selected from stock introduced from Java during the Hindu period. It is reported that *T. grandis* is well adapted to local conditions.

3239 Hollerwoger, F. 1957. **Compilations of information on methods used for inventory of teak forests with the aid of aerial survey**. FAO Teak Sub-Commission, Bandung FAO/TSC-57/9: 6p. FAO, Rome.

Determination of stand volumes directly from aerial photos has only just begun and has most promise for plantations.

3240 Kachhwaha, T.S. 1983. **Spectral signatures obtained from Landsat digital data for forest vegetation and land-use mapping in India**. Photogrammetric Engineering and Remote Sensing 49(5): 685-689.

Spectral signatures were used to delineate 11 land cover classes including forest areas of *Tectona grandis*.

3241 Karnataka Forest Department. 1977. **Forest wealth in Karnataka - resources survey data**. Myforest 13(2): 99-121.

Tables are given showing the growing stock and diameter distribution of 11 species including *Tectona grandis* in 11 forest divisions of Karnataka.

3242 Loetsch, F. 1956. **Inventory methods for tropical forests**. FAO/EPTA Report 545. FAO, Rome.

Reports the methodology of the survey of tropical zone in Thailand and gives volume tables for teak plantation and figures on merchantable volume and distribution of diameter classes.

3243 Loetsch, F. 1956. **The Siamese teak survey of 1956/57**. (German). Holz Zentralblatt 83(110): 1331-1333.

Discusses methods and the results of a survey covering 61,000 sq.km. in North Thailand, including volume figures for important species. The dangers to sustained yield from illegal fellings and shifting cultivation are stressed.

3244 Loetsch, F. 1957. **A forest inventory in Thailand**. Unasylva 11(4): 174-180.

Describes a method developed for an inventory of the northern teak-bearing provinces of Thailand. Sampling was based on stratification worked out from aerial photos. Field-sampling and computation methods are described, and costs estimated.

3245 Loetsch, F. 1957. **The method used for the Thailand forest inventory of the northern teak bearing provinces**. FAO Teak Sub-Commission, Bandung FAO/TSC-57-8: 7p.

Describes the methods of inventory followed in the teak-bearing forests of Thailand with the aid of aerial photographs. The sampling design followed is the tract-line system described in detail. The field sampling methods and problems are explained and the data to be measured inside the sample plots by each crew is indicated. The punch card tally sheets to be used for data collection are explained, and the statistical methods of analysis of data and error calculations are also explained.

3246 Loetsch, F. 1958. **Report to the Government of Thailand on forest inventory of the northern teak bearing provinces. Expanded Technical Assistance Programme, FAO, Rome**. FAO Report 895: 58p.

Provided a historical review of teak management in Thailand, sampling for the inventory, forest types and their stock structure, percentage of individual forest types in relation to total area sampled, volume of standing timber and recommendations for future management of teak.

3247 Lynch, T.B; Rusydi, R. 1999. **Distance sampling for forest inventory in Indonesian teak plantations**. Forest Ecology and Management 113(2/3): 215-221.

Distance sampling techniques were compared with point sampling and fixed-radius circular plot sampling for inventory of teak plantations in East Java, Indonesia.

3248 Maslekar, A.R. 1977. **Aerial assessment of young teak plantations of Allapalli Range, Maharashtra**. Indian Forester 103(7): 486-489.

Large scale black and white aerial photographs were taken of 8 teak plantations 3-140 ha in area and all less than 3 yr old. Successful areas, areas of poor growth, totally failed areas and patches of dense weed growth could be distinguished.

3249 Mokashi, V.K. 1956. **Study of sampling techniques in enumerations in forest**. Indian Forester 82(4): 171-175.

Sampling technique and the sampling intensity for estimation of growing stock with a reasonable accuracy are in progress in Bombay State. Certain results arising out of these investigations on complete enumeration data for one compartment of Dangs division are discussed. It was seen that random line-plot survey gave more precise estimates than strip survey for the same intensity of sampling.

3250 Myint Tin; Kyaw Tint. 1968. **Experiments on sampling in forest inventory**. Union Burma Journal of Life Science 1(1): 46-49.

A comparison was made between line-plot sampling with circles of 10 ft. radius and 30 ft. radius, and strip sampling in N. Toungoo forest division. Reported that the field work was hard and tiresome and strip and line-plot methods are not recommended for rough and hilly forests of Burma.

3251 Myint Tin; Tha Tun San. 1968. **Forest inventory in Minbyin reserve**. Union Burma Journal of Life Science 1(1): 50-61.

Gives details of a stratified two-stage sampling applied to collect data on the growing stock of species including *Tectona grandis*. Stratification was done with the help of past data, aerial photos and maps. The method was reported to be satisfactory in terms of precision and feasibility for application in hilly areas, but was time-consuming for enumeration and computation of the estimates.

3252 Naco, M.F. 1989. **Development and application of a forest screenometer for forest inventory**. Gregorio Araneta University Foundation, Philippines: 75 leaves.

Surveying was made easy with the use of screenometer because of its unique characteristics, easy to handle, easy to construct and manipulate.

3253 Nokoe, S; Agbavwe, C. 1993. **Determining the optimum number of strata for sampling a normally distributed forest population**. Discovery and Innovation 5(4): 301-305.

The purpose of the study was to determine the optimum number of strata in a forest population when the underlying distribution is normal, and the variable for stratification is either the variable of interest or a linearly related auxiliary variable. The technique used in both cases involved the combination of the Neyman allocation of strata sample sizes, Dalenius and Hodges cumulative square root frequency method, and a simple cost function of the form suggested by Dalenius.

3254 Oza, M.P; Srivastava, V.K; Pariswad, B.S; Setty, K.R.V. 1989. **Relationship between Landsat MSS data and forest tree parameters**. International Journal of Remote Sensing 10(11): 1813-1819.

Band ratios, indices and radiance in the four channels of the multispectral scanner on the Landsat-4 satellite were correlated with mean tree parameters of teak plantations in the north Kanara region of Karnataka. Age, mean tree height, mean tree d.b.h., mean canopy diameter and mean canopy volume were measured.

3255 Rao, T.K; Rao, S.V.V.S; Murthy, V.K. 1985. **Indian forests - an overview**. Indian Forester 111(8): 571-578.

A review of India's forests and changes in the forest area during different periods of time from 1951-52 to 1977. Teak forests comprise 12 percent of the forests.

3256 Seth, S.K. 1957 . **Inventory methods in teak forests in India**. FAO Teak Sub-Commission, Bandung, 1957, FAO/TSC-57/17: 3p.

3257 Seth, V.K; Tomar, M.S. 1973. **Contribution of small scale photographs in forest resources survey of East-Godavari**. Indian Forester 99(2): 92-99.

Photo interpretation resulted in much greater precision in estimating area, cover type and land use and facilitated the rapid production of maps for the selection of sites suitable for teak and eucalypt plantations.

3258 Sithidisairak, P. 1966. **Photo interpretation by using panchromatic film with different kinds of filter on mixed deciduous teak forest**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Green and yellow filters show more details about tone, texture, size and shape of the teak crowns in the stand.

3259 Soetrisno, H. 1980. **Definite measure of teak forest in Java**. (Indonesian). Gema Rimba 6(51/52): 11-13.

3260 Srivastava, V.K; Oza, M.P. 1991. **Identification of teak (*Tectona grandis* Linn.f.) plantations using multitemporal Landsat MSS data**. Indian Forester 117(3): 178-186.

Multitemporal Landsat MSS digital data collected over the Yellapur Forest Division, Karnataka were used to select a proper season and month for the identification of teak plantations. The data sets collected in different years for the different months were corrected for discrimination of teak from other natural forest types in the area.

3261 Steenis, C.C.G van. 1958. **Vegetation map of Malaysia**. In collaboration with UNESCO, for the UNESCO Humid Tropics Research Project. Scale 1: 5,000,000.

A physiognomic map compiled from many sources, indicating 18 types of vegetation including teak forests.

3262 Suranggadjiwa, M.H. 1969. **Inventory of teak and other industrial wood species**. Rimba Indonesia 12(1): 37-46.

3263 Tiwari, K.P. 1977. **Volume stratification for stratified sampling through pilot survey with aerial photographs**. Indian Forester 103(9): 592-601.

A pilot survey was made of an area in E. Karimnager Forest Division, Andhra Pradesh, using aerial photographs on a 1:40 000 scale. The forested areas in the photographs were classified by height and crown closure and by species including teak.

3264 Troup, R.S. 1911. **A note on some statistical and other information regarding the teak forests of Burma**. Indian Forest Records 3(1). Forest Research Institute, Dehra Dun.

Distribution, area, forest types and growing stock and yield statistics, rate of growth, exploitable age, yield and outturn from teak forests of Burma are dealt with.

3265 Watcharakitti, S; Eadkeo, K; Thammincha, S. 1972. **Stereogram of mixed deciduous forest with teak**. (Thai). Faculty of Forestry, Kasetsart University, Thailand, Forest Research Bulletin 21: 42p.

The main part of the report is a series of paired aerial photographs 1 inch square at scale 1:20 000 or 1:25 000, accompanied by a pair of terrestrial stereo photographs and annotations of stand characteristics. Recognition characters on the aerial photographs are given for teak crowns and for mixed deciduous forest with *Tectona grandis*.

3266 Zwart, W. 1941. **The survey and mapping of the teak forest of Java and Madura, 13th February 1860 - 30th June 1871**. (Dutch). Tectona 34: 235-285.

A historical review is given of this survey, which was the first to be made in Java and Madura.

Go top

Growth and Yield

(See also 0053, 0105, 0169, 0236, 0246, 0276, 0330, 0417, 1900, 2236, 2289, 2352)

3267 **Rate of growth of teak in Magayi plantations, Burma**. Indian Forester 18, 1892: 218-221.

Gives growth rate of teak plantations of 1872-77 of 15 to 20 years age from Magayi, Burma.

3268 **The dimensions of trees**. Indian Forester 22(12), 1896: p465.

Size of teak from Yamethin forest used for building Buddhist monstery is given as length 64 ft., mean girth 13'9". Two giant teak trees located measured 20' in girth and height 60' to first branch and another one with girth 17'4" at 5' from g.1. standing.

3269 **Extraordinary irregularity in the growth of teak: What is the cause?** Indian Forester 23(8), 1897: 291-294.

Describes the growth cycles in teak in which an alternate cycles of normal and abnormal slow growth, again after 10-40 years growth becomes normal. Slow growth cycle is due to damage by insects, crowding and overshadowing due to fast grown trees and damage by fire.

3270 **A big teak log**. Indian Forester 24, 1898: 320-321.

Gives the measurements of an old log 82.5 x 10'; the butt girth is 12-13 feet and top girth 7-8 feet.

3271 **Production of teak timber in Burma**. Tectona 4, 1911: p438.

3272 **Teak timber production in Siam**. (Dutch). Korte Medecelingen, 1911: 244-248.

3273 **Rafting and measuring teak logs in the Sillang River, Burma**. Indian Forester 43(9), 1917: 389-397.

3274 **Rough volume tables for teak, Pyinkado**. Burma Forest Bulletin (Silviculture 11) 15, 1926.

Rough volume tables for teak is given.

3275 **Height growth of teak and cutting back after frost**. Forest Research in India, 1930: p18.

3276 **Diameter increment of teak in Burma**. Forest Research in India, 1932: p44.

3277 **Rate of growth of teak in Burma**. Forest Research in India, 1932: p42.

3278 **The largest teak tree ever to be extracted**. Timber Trade Journal, 1964 .

The oldest teak log of an immense tree, estimated to be 750 years old and probably the largest teak ever to be extracted. It was 232 ft. long and 19 ft. 10 in girth.

3279 Achaya, T; Bhadran, C.A.R. 1961. **Yield regulation in the Madras forests**. Indian Forester 87(2): 631-645.

Discusses the working plan prescriptions in each of the forest types occurring in Madras state, including moist deciduous forests with *Tectona grandis* as the principal species. Yield regulation in teak plantations has been dealt with separately.

3280 Ackhurst, P.W; Micski, J. 1971. **Tanzania standard volume table for teak**. 48p. Forest Division, Ministry of Natural Resources and Tourism, Tanzania.

Presents tables of total volume and of merchantable volume based on measurements of 903 trees from all major plantations of *Tectona grandis* in Tanzania.

3281 Adegbehin, J.O. 2002. **Growth and yields of *Tectona grandis* (Linn. F.) in the Guinea and derived Savanna of Northern Nigeria**. International Forestry Review 4(1): 66-76.

Trial plantings of exotic tree species commenced as early as 1930s in some parts of northern Nigeria. Site index curves and yield tables were constructed for *Tectona grandis*. The application of the growth figures in the management of the species is discussed.

3282 Ahmed, G.U. 1992. **Height, diameter and age relationships of *Tectona grandis* Linn.f., *Syzygium grande* Sheele and *Dipterocarpus turbinatus* Gaertn**. Chittagong University Studies, Science 16(2): 7-10.

Data on diameter at breast height and height were collected from 19-40 yr old plantations of Bangladesh. Regression analysis showed highly significant correlations between the variables. The results are discussed in the context of determining the rotation age of the species.

3283 Akindele, S.O. 1989. **Teak yields in the dry lowland rain forest area of Nigeria**. Journal of Tropical Forest Science 2(1): 32-36.

The yield of teak plantations established by taungya in the Gambari forest reserve, Nigeria was assessed. The study involved the examination of the stand volume-age relationship in sample plots established in five plantations.

3284 Ambasht, R.S; Singh, A.K; Misra, K.N. 1982. **Energy conserving efficiency and productivity of a gradient of communities in Chakia forest ecosystem**. Tropical forests: Source of energy through optimisation and diversification: 209-218. Penerbit Universiti Pertanian Malaysia, Serdang, Malaya.

Phytomass energy was measured in a gradient of ecosystems on the lower Vindhyan plateau near Varanasi. Data are tabulated for energy storage, net energy fixation and energy conservation efficiency by biomass components and layers of including teak plantation.

3285 Andersen, K.P. 1972. **Bamboo management an outline**. (English; Bengali). Bano Biggyan Patrika 4(2/3): 17-31.

Presents a brief economic analysis of the yield and production costs growing either bamboo or teak in the bamboo producing areas of reserved forests of the Eastern Circle of Bangladesh.

3286 Appelman, F.J. 1926. **The new yield tables for cultivated teak forests**. (Indonesian; English). Tectona 19: 1011-1019.

The elaboration of a new correlated yield table for cultivated teak forest is considered to be premature having regard to the young age of these forests.

3287 Arpornratana, P. 1963. **Bark thickness of teak at breast-height in various site and size**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Six plots were measured to calculate bark thickness. The bark thickness at breast-height increases for increase in diameter of 10 cm.

3288 Arun Kumar, A.N; Srinivasa, Y.B. 2003. **Stand level radial growth rate pattern reveals growth convergence in *Tectona grandis***. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Tested the hypothesis that radial growth rates of trees belonging to different radial classes converge towards the end of the juvenile phase through stump analysis of teak. Growth pattern of 168 teak trees was analyzed after classifying the trees into 4 cohorts based on the radial growth accumulated over the initial 20 years. Correlations show that growth upto 15 years had a significant impact on the cumulative growth. Discuss the implications of this study for the management of teak trees.

3289 Asiddao, F; Nastor, M. 1960. **Analysis of data on growth study of teak (*Tectona grandis* Linn.f.) in Bohol reforestation project, Colonia, Carmen, Bohol**. Philippine Journal of Forestry 16(3/4): 183-193.

Analyses increment data from a sample plot established in 1950.

3290 Bacilieri, R; Alloysius, D; Lapongan, J. 2000. **Growth performance of teak**. Proceedings of the Seminar on High Value Timber Species for Plantation Establishment Teak and Mahoganies, Sabah, 1-2 December 1998. JIRCAS Working Report 16: 27-34. H.H. Chan; K. Matsumoto, Eds.

The growth performance of teak in several regions of the world was studied and compared to the growth rates obtained in several trial plots in Malaysia. Formulae describing the relationships between age, height, volume, total timber yield and yield of stem wood in other regions of the world like Central America, Cote d'Ivoire, India were used to estimate the yield of plots in Sabah.

3291 Batista, M.P; Woessner, R.A. 1983. **Comparison of the growth of four exotic species on podzolic soils of the Amazon**. (Portuguese). Floresta 14(1): 29-35.

3292 Beekman, H. 1913. **Research into the most suitable method of measurement of teak stems in a stand**. (Indonesian). Tectona 6: 367-422.

3293 Beekman, H. 1915. **An investigation about the most accurate method of measuring teak tree and teak stands**. (Indonesian; English). Meded Proefsta Boschw 1: 93p.

3294 Beekman, H. 1917. **Investigation into the increment in secondary natural teak wood in North Japara**. (Indonesian; English). Meded Proefsta Boschw 2: 1-32.

3295 Bermejo, I; Canellas, I; San Miguel, A. 2004. **Growth and yield models for teak plantations in Costa Rica**. Forest Ecology and Management 189(1/3): 97-110.

Volume equations for commercial teakwood, site index curves and provisional empirical yield tables were developed for teak at Bosque Puerto Carrillo S.A. plantations in Costa Rica.

3296 Beumee, J.G.B. 1917. **Measurement of the height of the standing trees**. (Indonesian; English). Meded Proefsta Boschw 2: 33-48.

3297 Bhat, D.M. 1990. **Litter production and seasonality in tropical moist forest ecosystems of Uttara Kannada district, Karnataka**. Proceedings of the Indian Academy of Sciences, Plant Sciences 100(2): 139-152.

Small litterfall, ground litter and large wood litterfall were quantified at five forest sites including teak forests in Uttara Kannada district. Seasonal variation was distinct at monocultural sites and in vegetation types dominated by few species. Small litterfall and ground litter production were highest in the dry season and they were negatively correlated with mean monthly rainfall.

3298 Bhat, K.M; Indira, E.P. 1997. **Teak timber production in intensively managed plantations of the tropics**. Proceedings of the 11th World Forestry Congress, Antalya, Turkey.

3299 Bhudimitra, M. 1962. **Study of teak growth in permanent sample plots**. (Thai). Student Thesis. Kasetsart University, Bangkok.

In best soils the basal area increment annually is 59.737 sq. cm. per year per tree or 962.5833 sq. cm. per year per rai.

3300 Bhumibhamon, S. 1968. **The correlation between the growth in diameter of teak (*Tectona grandis* Linn.f.) and the depth of A-horizon at Klang dong teak plantation, 1956**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Diameter growth is significant to A-horizon depth (r=0.9872) and gives a regression y=-9.8779+2.1815 x. Again it was observed that diameter at 0.30 m is correlated with A-horizon depth (r=0.8934) and y=-11.0840+1.8569 x).

3301 Blanford, H.R. 1921. **Rough volume tables for teak (*Tectona grandis*) Pyinkado (*Xylia dolabriformis*), in (*Dipterocarpus tubercula-***

***tus*), Taukkyan (*Tetminalia tomentosa*), in Burma**. Burma Forest Bulletin (Silviculture 9) 10: 10p.

3302 Blanford, H.R. 1922. **Rough volume tables for teak, Tharrawady Division**. Burma Forest Bulletin 6 (Silviculture Series): 6p.

Based on measurements in Kyathaung and Myinwa and Tharrawady, curves are drawn from which volumes were read for different girths at b.h. for lengths of logs 3-10 ft. and average volumes of trees are presented in 3" girth classes. From volume curves volume tables are constructed in 6" girth classes and also increment is given for different areas.

3303 Boonyoparch, C. 1965. **Volume tables for some timber species of Thailand**. Royal Forest Department, Bangkok R.74. Kasetsart University, Bangkok.

Gives tables for teak for various diameters and girths.

3304 Boonyoparch, C. 1966. **Girth measurement of teak**. Proceedings of First Forestry Conference, Royal Forest Department, Bangkok: p282.

A new table for measurement of girth of teak is given which is already used for forest-inventory in North Thailand.

3305 Bourne, R. 1922. **Methods of preparing volume and money yield-tables for teak woods and volume and form-factor tables for teak trees from data collected in the Nilambur teak plantations of the South Malabar Division, Madras, S. India, 1916-1919**. Forest Department Ledger files, Madras and FRI, Dehra Dun.

3306 Brandis, D. 1879. **Memorandum on the rate of growth of teak**. Indian Forester 4(3): 215-225.

All available information is presented which cover information on girth and height at different ages, cubic content of tree at different ages and number of trees and cubic content of the growing stock per acre.

3307 Brasnett, N.V. 1950. **The Brandis system of yield regulation**. Journal, Oxford University Forestry Society (Series 3) 5: 15-22.

A detailed exposition of the method devised by Brandis in 1858 to regulate the yield of teak from the forests of Burma.

3308 Budiantho, D. 1986. **Site index model of teak (*Tectona grandis*) plantation**. (Indonesian). Buletin Penelitian Hutan, Pusat Penelitian dan Pengembangan Hutan 476: 46-61.

Data from selected dominant and codominant trees were used to derive a prediction equation for site index based on upper height and age of the stand.

3309 Budiantho, D. 1995. **Relationship of age, stand density and site index for diameter distribution of a teak stand (*Tectona grandis*, L.f.)**. (Indonesian). Buletin Penelitian Hutan 581: 11-36.

Test were made of the capability of the beta-function in representing the diameter distribution of teak stands. Diameter was expressed as a function of several variables, viz. age, site index, stand density, number of trees per hectare or average distance of trees per hectare. There were no significant differences in regressions based on the 4 different diameter measurements.

3310 Chakrabarti, S.K; Gaharwar, K.S. 1995. **A study on volume estimation for Indian teak**. Indian Forester 121(6): 503-509.

Inventory surveys were carried out for estimating the growing stock and has developed a number of local volume equations based on ground diameter mid-point. Two relationships have been established using the Method of Least squares; one is linear and the other a parabolic relationship. The volume of teak can be estimated using the parabolic relationship.

3311 Chalermpongse, A. 1992. **Growth performance in different age-classes of Huay-Tak teak plantation**. Proceedings of the Seminar on 50 Anniversary of Huay-Tak Teak Plantation, Lampang, 5-8 August 1992.

A study was made to assess the growth habits and yields of teak planted in Huay-Tak teak plantation, Lampang province, Thailand. The overall growing stocks of the teak plantation in term of merchantable volume in all age-classes was illustrated and the mean volume provided.

3312 Champion, H.G. 1932. **Branch and small wood tables for *Shorea robusta* and *Tectona grandis* etc**. Indian Forest Records (Silviculture Series) 15(6).

3313 Champion, H.G. 1934. **Rough volume tables for teak**. Indian Forester 60(10): p724.

Recommended for use in all teak growing areas.

3314 Champion, H.G. 1934. **Von Wulfing's yield tables for teak plantations in Java**. Indian Forest Bulletin 87: 30p.

Wulfing's yield tables are converted from metric to British system and compared with growth rates and yield tables for Nilambur plantations. Observations are made on site qualities and growth rates at both places.

3315 Chandhrapanukorn, B. 1964. **Correlations between diameter at breast height, height of buttress and diameter at the buttress height of teak**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The study establishes a correlation between dbh and diameter at highest point of buttress and dbh and height of buttress and diameter at the highest point of buttress and height of buttress.

3316 Chanpaisaeng, S. 1992. **Yield of teak plantation**. Proceedings of the Seminar on 50 Anniversary of Huay-Tak Teak plantation, Bangkok, 5-8 August, 1992.

3317 Chaturvedi, A.N. 1973. **General standard volume tables and height/diameter relationship for teak (*Tectona grandis*)**. Indian Forest Records, Silviculture 12(8): 1-8.

Presents tables for merchantable timber volumes and small wood volumes and two regression equations for height/d.b.h. relations of teak, based on data from Kerala, Madhya Pradesh, Mysore, Orissa, Tamil Nadu and Uttar Pradesh.

3318 Chiao, K.M. 1968. **Relationships of dbh, basal diameter and diameter at 5.3 m. in *Cryptomeria japonica* and teak**. (Chinese). Exp. For. Taiwan University, Miscellaneous Paper 40: 20p.

3319 Chittranshi, V.N; Chitwadgi, S.S. 1971. **Standard volume table for teak for South Chindwara Division in Madhya Pradesh**. Technical Bulletin 9.

3320 Choosapya, Ch. 1962. **A volume of teak branches as determined from 5 c.m. diameter to the tip**. (Thai). Student Thesis. Kasetsart University, Bangkok.

For d.b.h. class 30-35, 35-40, 40-45, 45-50, 50-55, 55-60 and 60-65 cm, the volume of the branches 0.071 m3, 0.086 m3, 0.101 m3; 0.114 m3; 0.137 m3 and 0.174 m3 respectively.

3321 Chotiyabutta, S. 1961. **Correlation between the depth of A-horizon and teak height in Mae-Huad teak plantation (1942)**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Sixty-six experimental plots were laid out in 410 Rai within radius 12.65 m and soil depth upto 12 cm was examined and no significant correlation was observed.

3322 Chowdhury, K.A. 1952. **Rate of growth and quality of tropical woods**. Forest Research Institute, Dehra Dun: 2p. (6th British Commonwealth Forestry Conference, Canada, 1952).

The correlations between strength and rate of growth that have been established for timbers of the temperate zone are only partially applicable to tropical timbers. In the ring-porous teak, very fast-grown wood is weak and spongy.

3323 Cordero, L.D.P; Kanninen, M. 2003. **Provisional equations for estimating total and merchantable volume of *Tectona grandis* trees in Costa Rica**. Forests, Trees and Livelihoods 13(4): 345-359.

A study is made to develop equations to predict individual tree total volume and merchantable volume for teak in plantations in Costa Rica.

3324 Cordero, L.D.P; Kanninen, M. 2003. **Above ground biomass of *Tectona grandis* plantations in Costa Rica**. Journal of Tropical Forest Science 15(1): 199-213.

This paper reports the distribution of aboveground biomass of teak and its relationship with diameter at breast height, age and stand density in plantations across Costa Rica. Foliage, branch, stem and total aboveground biomass were highly correlated with dbh and age.

3325 Cordero, L.D.P; Ugalde Arias, L.A; Kanninen, M. 2000. **Development of growth scenarios for teak (*Tectona grandis*) plantations in Costa Rica**. (Spanish). Revista Forestal Centroamericana 31: 16-22.

A study was made with the objective of developing preliminary forest management proposals for teak plantations to ensure high stand productivity. Models were developed for different relationships among the variables crown composition, crown structure, growth and productivity, using information from advanced aged teak plantations in Costa Rica.

3326 Das, M; Baruah, C.K. 1996. **Studies on seasonal variation in the leaf litter production of teak (*Tectona grandis* Linn.f.)**. Advances in Plant Sciences 9(1): 85-92.

Leaf litter production was studied on the forest college campus at Jalukbari, Assam. There was variation in litter production between sites and seasons. The trend was a gradual increase from January, reaching a peak in March, and then a sharp fall after March, reaching a minimum in June. A second gradual increase was observed from July onwards.

3327 Das, S. 1966. **Standard volume tables for Bori (Hoshangabad) teak**. Indian Forest Records (n.s.) (Statistical) 1(2): 51-60.

The tables were constructed from regression equations of volume on basal area.

3328 Datta, M. 1997. **Growth performance and biomass production in twelve multipurpose tree species in Tripura**. Journal of Hill Research 10(1): 51-56.

Growth performance and aboveground biomass productivity were recorded for twelve multipurpose tree species including *Tectona grandis* planted in an arboretum at Tripura. Fresh leaf biomass and stem volume were highly correlated with basal girth, girth at breast height and height of the tree species in the arboretum.

3329 De Milde, R.A.J. 1984. **Some practical tables to estimate the potential of teak plantations**. 12p.

3330 Deventer, A.J van. 1923. **Production of teak in the intensively managed forest districts of Java**. (Dutch; English). Tectona 16: 7-39.

Figures in tables indicate a correlation between transportation facilities and production of best classes of timber, and inadequate facilities result in low production and results indicate intensifying the management of teak forests.

3331 Deventer, A.J van. 1925. **Production of teak in Java**. Botany Abstract 14: p498.

3332 Draaisma, C.L.M. 1917. **Observations on diameter growth in teak**. (Dutch). Tectona 10: 575-580.

3333 Dupuy, B; Maitre, H.F; Kanga, A.N. 1999. **Teak (*Tectona grandis*) production table: The Cote d'Ivoire example**. (French). Bois et Forests des Tropiques 261: 6-16.

Constructed a yield table using data from sample plots in teak plantations in the Cote d'Ivoire and discussed yield classes for this species, which is planted from the savanna region in the north of the country to closed evergreen forests of the southern coastal regions. Five distinct productivity levels, associated with site fertility and rainfall, have been noted.

3334 Ferguson, J.H.A. 1934. **Thickness of heartwood and sapwood of teak (*Tectona grandis* Linn.f.)**. (Dutch; English). Tectona 27(5/6): 313-327.

From the investigations carried out it appears that for the same stem diameter there is more sapwood if the growth is faster as is the case of better quality areas. It also appears that the sapwood increases with the height of the cross section above the ground.

3335 Ferguson, J.H.A. 1934. **On the correlation between sapwood and total leaf weight in teak**. (Dutch; English). Tectona 27: 512-513.

3336 Ferguson, J.H.A. 1935. **The stem volume of plantation grown teak (*Tectona grandis* Linn.f.)**. (Dutch; English). Tectona 28(2): 83-94.

The mean height of crown base which depends on age did not change with quantity. Mean height of crown base in meters and total stem volume under bark for 5-100 years are given.

3337 Ferguson, J.H.A. 1950. **Indicator graph for Java teak**. (Dutch; English). Tectona 40: 359-364.

The indicator graph constructed for teak after Hiley (1930) and money yield tables of Hellinga (1940) is explained. Hiley's and Faustmann's formula are also discussed.

3338 Ferguson, J.H.A. 1953. **Considerations on the computation of diameter growth by diameter classes, from stand tables**. Proceedings of Congress of International Union of Forest Research Organisations, Rome, 1953 Section 25(2): 9p.

The results of determining increment using Prodan's method, either from individual tree diameter records or from stand tables, are compared for species including teak.

3339 Fischer, C.E.C. 1922. **Rate of growth of teak for Trinidad**. Indian Forester 48(4): 213-214.

Gives a brief history of the introduction of teak in Trinidad, method of razing the plantations and subsequent care. Figures of growth rate is also given.

3340 Forest Department, Burma. 1934. **Rough volume tables for teak (*Tectona grandis*)**. Burma Forest Bulletin 31: 1-97.

The outturn volume tables are given for 25 forest divisions. To facilitate selection, a brief description of the locality is also given in respect of each type.

3341 Forest Department, Sudan. 1954. **Rate of growth of teak (*Tectona grandis*)**. Report of Forest Department, Sudan 1952/53: 42-43; 46-50.

Measurement of sample plots of teak in different parts of the southern Sudan shows that, in general, diameter growth is better than for trees of the same height grown in India. On the better sites growth is equal to All India quality II, which is the first quality of the Nilambur plantations in Madras. Even the lower quality teak has already produced a considerable revenue from thinnings, as its straight clean poles are in high demand.

3342 Forest Department, Uttar Pradesh. 1967. **On a giant teak tree in S. Chanda Division, Maharashtra**. Aranya, November 1967: p10. Forest Department, Uttar Pradesh.

Mention is made of a teak tree with the following measurements in South Chanda division, Maharashtra state: height - 43 m, Diatmeter - 792 cm.

3343 Forest Research Institute, Dehra Dun. 1917. **Teak growth statistics**. Indian Forest Records (n.s.) Silviculture 6(2): 42p. Forest Research Institute, Dehra Dun.

3344 Forest Research Institute, Dehra Dun. 1928. **Teak volume tables for Central Provinces**. Forest Research in India, Forest Research Institute, Dehra Dun: p78.

3345 Forest Research Institute, Dehra Dun. 1932. **Branch small-wood tables for *Shorea robusta*, *Tectona grandis*, *Cedrus deodara*, *Pinus excelsa*, and *P. longifolia***. Indian Forest Records (n.s.) Silviculture 15(6).

3346 Forest Research Institute, Dehra Dun. 1959. **Yield and stand tables for plantation teak (*Tectona grandis* Linn.f.)**. Indian Forest Records (n.s.) Silviculture 9(4): 151-216.

Four quality classes are distinguished. The revised yield tables show comparatively less height growth for all site quality classes as compared to the previous one but comparatively higher diameters for the same age and the same quality.

3347 FORSPA, Bangkok. 2000. **Site, technology and productivity of teak plantations**. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 273p. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

Selected papers presented at the seminar are compiled. A paper on the global situation of teak plantations and several papers highlighting teak plantation management issues in different countries like Bangladesh, Brazil, China, Costa Rica, Cote d'Ivoire, India, Indonesia, Malaysia, Myanmar, Sri Lanka and Vietnam are included. Papers dealing with specific topics such as tree improvement, mass propagation, disease and pest management, and productivity and economics are also included.

3348 Friday, K.S. 1987. **Site index curves for teak (*Tectona grandis* Linn.f.) in the limestone hill region of Puerto Rico**. Commonwealth Forestry Review 66(3): 239-253.

Height growth curves are proposed for site index classification in this subtropical moist to wet region. The new curves are similar to those for Burma, Trinidad and the Caribbean/Central American region. Most plantations had a reasonably good site index.

3349 Ghosh, R.C. 1968. **Productivity of North Bengal plantations-a study**. 9th Commonwealth Forestry Conference, New Delhi 1968.

Included the history of the plantation and data on increment and yield of teak.

3350 Gilbert, G. 1932. **Growth of teak in Dutch East Indies**. Boil Abstract 6(22965).

3351 Gonzales, L.L. 1985. **Growth and yield prediction model for teak (*Tectona grandis* Linn.f.) plantations in the Magat Experimental Forest. Part 1. Tree volume equations and tables**. Sylvatrop 10(4): 231-241.

Volume equations and tables were developed for merchantable and saw timber heights from models chosen by stepwise regression with data from Nueva Vizcaya, Philippines.

3352 Gonzalez, R.M. 1970. **The yield of forest plantations in the tropics**. (Spanish). Annales Cientificos, Departamento de Publicaciones de la Universidad Nacional Agraria, La Molina 8(1/2): 109-121.

Included published information on the yield of plantations of *Tectona grandis* in tropical Latin America.

3353 Gouveia, V.M; Angelo, H. 2002. **Economic analysis of carbon fixation and storage in a population of *Tectona grandis* Linn.f.** (Portuguese). Brasil Florestal 21(74): 23-36.

An economic investigation of carbon fixation and storage due to the production of a population of *Tectona grandis* in order to determine its rotational period is made. Using volumetric production and density data, the oven-dry mass and carbon content was fixed upon 50 percent.

3354 Goyal, A.K. 2001. **Giant teak tree located in Malayattoor Forest Division, Thrissur, Kerala**. Indian Forester 127(6): p729.

The giant teak, *Tectona grandis*, growing in Malayatoor Forest Division, Thrissur, Kerala and another one near it are described.

3355 Grainger, A. 1988. **Future supplies of high grade tropical hardwoods from intensive plantations**. Journal of World Forest Resource Management 3: 15-29.

Projections were made of future production of high grade tropical hardwoods including teak from intensive forest plantations for 30 countries in the humid tropics for the period 1981 to 2026.

3356 Griffith, A.L. 1946. **The efficiency of enumerations. XII. One species in a mixed forest (teak in a Madras moist mixed deciduous forest). XIII. Confirmation of the Chir (*Pinus longifolia*) and sal (*Shore robusta*) data. XIV. Summary of indications**. Indian Forest Leaflet (Silviculture) 93: 14p .

Dealt with enumerations of teak in Madras moist mixed deciduous forest.

3357 Habibullah Sahib, M. 1918. **Measurement of a teak tree**. Indian Forester 44: p468.

Gives dimensions of a big teak tree felled in Tekkadi forests of South Coimbatore Division. The tree had a girth of 18'7" at b.h. and 30' length of workable stem, which on felling yielded 11 logs of 129 ft. length and 711 cu.ft. of timber.

3358 Haeruman, H. 1965. **Top height in the classification of teak stands**. Rimba Indonesia 10(4): 275-282.

Site class of even-aged stands in Indonesia is determined by using age, mean diameter, mean height and top height.

3359 Harne, J.E.M. 1962. **Growth rates in the timber plantations of Western Nigeria.** Nigerian Forest Information Bulletin 12: 16p.

Tabulated data on height, g.b.h., basal area, volume and increment is given for teak and other species.

3360 Hellinga, G. 1939. **Stand table for normal teak plantations thinned in the lower storey**. (Dutch). Boschbouwproefstation, Buitenzorg: 96p.

3361 Hobbins, R. 1935. **Some notes on the percentage loss in the timber volume of teak due to bad form, natural defects and breakage in felling**. Indian Forester 61(11): 693-698.

The average percentage of loss of timber by butting due to splits, cracks, bear bites, top hollows, felling damages and all defects was estimated to be 7.32 percent in volume.

3362 Hole, R.S. 1901. **Irregularity in the growth of teak**. Indian Forester 27(8): 393-397.

The author is of the opinion that the extraordinary irregularity on the growth of teak is due to insect attack and defoliation by *Paliga damastesalis* and *Hyblaea puera*.

3363 Hollerwoger, F. 1954. **Is there a correlation in the teak forests between crown diameter and the height of the trees with regard to the diameter at breast height?** Journal of Scientific Research in Indonesia 3(1): 3-20.

Results of a survey made in a teak area in Ledok, Central Java, show that there exists no direct relation between crown diameter and stem diameter because of the fact that teak reaches its maximum crown diameter at an age when d.b.h. is still steadily increasing and in old trees, crowns may become smaller, whereas d.b.h. may still increase.

3364 Hoque, M.A. 2000. **Site, technology and productivity of teak plantations in Bangladesh**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 35-50. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

Bangladesh has a long history of teak plantation management and most plantations are owned by the Government. In addition plantations raised by private enterprises, industries, semi-autonomous corporations, farmers and small holders are also there. Activities initiated by the Bangladesh Forest Research Institute to meet the demand for superior stock of teak are discussed. A financial analysis of teak plantation in Bangladesh is also made.

3365 Isfiati, S. 2001. **Evaluation of the stumpage value growth on teak forest in KPH Jember PT Perhutani Unit II East Java**. (Indonesian). Jurnal Sosial Ekonomi 2(2): 99-110.

It is showed that the physical stumpage and monetary growth of teak stands increased between 1979 and 1989 and decreased during 1989-99. It is suggested that an understanding of the annual forest resource growth could be used for evaluating forest management on sustainable principles.

3366 Islam, S.S. 1984. **Volume tables for some indigenous forest species in Bangladesh**. Bangladesh Forest Research Institute, Forest Inventory, Bulletin 3: 70p.

Developed 15 regression models of tree volume and the models were compared and the best used to compute single and double entry volume tables. These are presented for 14 species including *Tectona grandis*.

3367 Islam, S.S. 1988. **Commercial volume table for teak (*Tectona grandis* Linn.f.) in Bangladesh by regression technique**. Bano Biggyan Patrika 17(1/2): 55-67.

Commercial volume tables were derived for teak. Thirteen models of the variation of volume with d.b.h. and with d.b.h. and height were compared. Equations are given for the relations between d.b.h. and height. One- and two-way volume tables based on the equations are presented.

3368 IUFRO. 1981 . **Industrial wood production via plantations: A. Growth, yield, economics**. Wood production in the neotropics via plantations. IUFRO MAB USDA Forest Service. IUFRO Working Group S1.07.09, Puerto Rico, 8-12 September 1980: 18-135.

Included two papers on teak by Keogh, R.M. 1. Teak (*Tectona grandis* Linn.f.) Volume growth and thinning practice in the Caribbean, Central America, Venezuela and Colombia. 2. Teak (*Tectona grandis* Linn. f.): Provisional site classification chart for the Caribbean, Central America, Venezuela and Colombia.

3369 Iyer, K.R.V. 1913. **The tallest teak tree in the Shola forest, South Malabar, India**. Indian Forester 39(4): 173-175.

Reported a teak tree in Edkulli shola forests in Kahumpoya valley with 192 ft. in height and clean bole up to 1st branch of 114 ft. and g.b.h. is 15'10" at 4.5' b.h. and age estimated to be over 200 years.

3370 Jayaraman, K. 1998. **Structural dynamics of teak stands in Kerala**. KFRI Research Report 141: 28p. Kerala Forest Research Institute, Peechi.

Teak plantations in Kerala under the management of the Forest Department occupied around 78 225 ha in 1992. The teak plantations falling under the Territorial Circles were assessed for stocking and site quality distribution using a stratified sampling procedure, based on Territorial Circles and age groups. It is found that 36 percent of the plantation area was under stocked, and 45 percent overstocked. Data are presented on the status of these plots with respect to stand attributes such as age at measurement, stand density, site quality class etc. The consequence of bringing the plantations to normality in one rotation period was also investigated.

3371 Jayaraman, K; Bailey, R.L; Rugmini, P. 1986. **Height measurements of plantation grown teak using multimeter and relascope**. Malaysian Forester 49(3/4): 313-316.

The relative accuracy of height measurements made using a relascope and a multimeter was investigated in Kerala. Average differences between the measurements were 13 percent. There was no systematic difference in measurements made by the 2 instruments.

3372 Jayaraman, K; Chacko, K.C. 1999. **Modelling the growth of teak and real time monitoring of tree health in STM teak plantations**. KFRI Research Report 175: 22p. Kerala Forest Research Institute, Peechi.

The works executed with the objective of developing a Management Information System (MIS) for plantations owned by STM are reported. The data collected include location details, several attributes related to growth and health of trees, soil status, input operations carried out and weather conditions in the plantations. The overall mean annual increment of height in STM plantations during the initial three years of growth was found and compared of All India Yield Table for teak.

3373 Jayaraman, K; Krishnankutty, C.N. 1990. **A data bank for forestry sector in Kerala**.

KFRI Research Report 66: 27p. Kerala Forest Research Institute, Peechi.

Teak and eucalypts account for the major share of the area under plantations in Kerala. A computerized data base and retrieval system was developed for plantations in Kerala, with reference year 1978-88. The system was instantly retrieve information pertaining to any set of plantations in the State with regard to the location, species and year of planting. The utility of such a management information system is demonstrated by making projections of yield from teak plantations in Kerala in a full rotation age in the future.

3374 Jayaraman, K; Lappi, J. 2001. **Estimation of height diameter curves through multilevel models with special reference to even-aged teak stands**. Forest Ecology and Management 142(1/3): 155-162.

The use of a multilevel model for estimation and prediction of height-diameter curves in planted teak stands is discussed in the context of analysing data from a stratified two-stage sample survey. Differences in the height-diameter curves among the different Territorial Divisions were also investigated. The models are useful in generating accurate predictions of tree height which would eventually lead to better tree volume predictions and evaluation of site quality.

3375 Jayaraman, K; Nandakumar, U.N; Rugmini, P. 1987. **Estimation of stocking in teak plantations**. Indian Journal of Forestry 10(1): 60-61.

A high coefficient of variation was found in estimations of mean stocking in a teak plantation established at Nilambur, Kerala. Theoretical sample sizes required to estimate stocking with specified levels of accuracy were determined by Rustagi's formula which indicated a need for a sampling intensity of 11.25 percent for a 95 percent confidence level. This is not practical in the field.

3376 Jayaraman, K; Rugmini, P. 1988. **Diameter distributions for even-aged teak**. Indian Journal of Forestry 11(2): 145-147.

The suitability of the mathematical functions, weibull and the beta distributions for representing the frequency distribution of diameter in even-aged teak was tested using the data on diameter at breast-height collected from plantations at Nilambur, Kerala. The observed diameter distribution was nearly symmetrical and platykurtic and was better fitted by the more flexible beta distribution than by the weibull distribution.

3377 Jayaraman, K; Rugmini, P. 1993. **Variation in the productivity of teak plantations in Kerala**. Proceedings of the 5th Kerala Science Congress, Kottayam 28-30 January 1993: 179-181. R. Ravikumar, Ed. State Committee on Science, Technology and Environment, Thiruvananthapuram.

Variation in the productivity levels of teak plantations raised during the last one rotation period was examined. There were distinct regional differences in productivity with respect to the proportion of area under different site quality classes. The range of variation could be partitioned into three natural levels of low, medium and high productivity and regions falling in these classes could be identified through clustering procedure. The average expected yields worked out for the three clusters showed large difference which have implications on the management of these plantations.

3378 Jha, M; Puranik, C.P; Subramanian, K. 1998. **Stand development patterns in pure teak plantations**. Indian Journal of Tropical Biodiversity 3/6(1/4): 1-5.

This paper presents the stand development patterns in a teak plantation and is compared with the mature natural teak stand. Results indicate that teak plantation after clear felling approaches towards the natural stand as appeared from ratios of non teak trees to teak trees. It will help for the study of stand dynamics and yield prediction.

3379 Jiayu, B; Kunnan, L. 2000. **Site, technology and productivity of teak plantations in China**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 123-136. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

Discussed the condition under which teak is grown, management practices and establishment and maintenance costs of teak in China. Author is of the opinion that due to the application of better planting techniques and the use of improved seeds, teak plantations have a bright future in China.

3380 Jinaporn, B. 1966. **Study on the correlation between volume of teak in natural forest and stand profile**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The natural forest volume is found to be 14.66 m3/0.1 ha. and the stand profile is 1962.88 m3/0.1 ha.

3381 Jones, N. 1964. **Provisional volume table for teak**. Department of Forest Research, Nigeria, Technical Note 32: 10p.

Local tables for the three largest W. Nigeria plantations.

3382 Kaitpraneet, W; Sukwong, S. 1974. **Height growth of teak (*Tectona grandis* Linn.f.) as related to environmental factors**. Forest Research Bulletin, Faculty of Forestry, Kasetsart University, Thailand 30: 21p.

A regression analysis for the estimation of height was derived from data on stand, soil and topographic factors in teak plantations of different ages in N. Thailand. It was found from the equation that teak requires soil of deep A-horizon with adequate soil moisture for development and as the number of stems per rai decreases, height growth increases.

3383 Kandya, A.K. 1973. **Notes on net primary production in teak (*Tectona grandis* Linn. f.)**. Journal of the Indian Botanical Society 52(1/2): 40-44.

Reports a study of annual dry-matter production by seven trees growing in dry deciduous mixed teak forests near Sagar, Madhya Pradesh. The results, based on actual weighings of the various plant parts after felling, indicate that maximum productivity of 25.81 kg/year/tree occurs between 33 and 50 years of age.

3384 Kandya, A.K. 1974. **Weight dynamics in immature *Anogeissus*, *Tectona* and *Terminalia***. Indian Forester 100(2): 93-100.

It is found that for the species including teak, total above-ground dry weight per tree was 80-83 kg.

3385 Karmacharya, S.B; Singh, K.P. 1992. **Biomass and net production of teak plantations in a dry tropical region in India**. Forest Ecology and Management 55(1/4): 233-247.

An analysis of the standing crop biomass and above-ground net production was made by non-destructive methods. Allometric regressions were developed relating girth to weights of bole wood, bark, branch, leaf and inflorescence. Annual girth increments were recorded and above-ground biomass is found ranged from 25.7 to 76.9 t/ha.

3386 Karunakaran, C.K. 1984. **Biomass of Kerala forests**. Indian Forester 110(9): 841-853.

Preliminary estimates are given of the growing stock per ha of the different types of natural and man-made forests in Kerala. For teak and *Eucalyptus tereticornis* plantations they are as low as 70-80 m3 and 30 t.

3387 Keogh, R.M. 1990. **Growth rates of teak (*Tectona grandis*) in the Caribbean/Central-American region**. Forest Ecology and Management 35(3/4): 311-314.

Previous examinations of teak in Caribbean and Central America suggested a slowing down in height growth through time in comparison with teak in indigenous areas. It was suggested that, in the case of an existing regional classification chart, the basic model used might be responsible for this observation rather than biological factors.

3388 Keogh, R.M. 1996. **Teak 2000: A consortium support model for greatly increasing the contribution of quality hardwood plantations to sustainable development**. IIED Forestry and Land Use Series 9: 26p. International Institute for Environment and Development, London and The Amazon Teak Foundation, Amsterdam.

Consortium Support Model (CSM) is a system under which financial and technical support will be given to groups of teak growers to enable them to produce more and better quality teak in a socially and environmentally preferred manner. The CSM is designed to satisfy environmental requirements as well as to benefit investors, growers, processors, local communities and the market. The aims of the model are discussed and justified, and its structure is described.

3389 Kesornsiri, K. 1968. **Teak stem-analysis in Trachai teak plantation**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The height, basal area and volume of first year and at the age of 25 years are provided for teak.

3390 Khali Aziz Hamzah; Azmy Hj Mohamed. 1994. **Volume equations and tables for teak (*Tectona grandis* Linn.f.) in Mata Ayer, Perlis, Malaysia**. Forest Research Institute Malaysia Reports 65: 19-33. Forest Research Institute Malaysia, Kuala Lumpur.

The paper attempts to establish equations which best relate the relationship between volume, diameter at breast height and total height, by the least squares method, for the construction of volume tables for *Tectona grandis*.

3391 Khemnark, C. 1962. **Local merchantable volume tables of teak at Mae-Huad forest, Lampang**. (Thai). Student Thesis. Kasetsart University, Bangkok.

For the form-class 0.739 the volume table can be used for teak which has a form class equal to that volume by measuring d.b.h. and merchantable height.

3392 Kittinanda, S.P; Yingransiri, T. 1968. **Annual increment of teak plantation at Mae-Huad and Huay-Rai in different ages**. (Thai; English). Proceedings of the Forest Silvicultural Seminar, Royal Forest Department, Bangkok R 118: 203-209.

The growth of teak in Mae-Huad plantation in first three years is faster and is attributed to fertile soils of the forests, where as in other areas the fertility of soils is poor due to shifting cultivation. The general condition of forest soils and their fertility status are discussed.

3393 Kivung, D. 1986. **The growth and yield potential of teak (*Tectona grandis* Linn.f.) in Papua New Guinea plantations**. Klinkii 3(2): 2-19.

Growth data were collected at two sites by the methods of destructive sampling and photogrammetry and used to compile volume tables. Graphs showing height and diameter growth, and tables giving site quality data and d.b.h. and b.a. increment from 5 to 16 yr old are also given.

3394 Klaithong, P. 1964. **Estimation of production in mixed-deciduous forests with teak**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The production in wet-mixed deciduous forest is estimated as 26.7 tons/Rai of which teak is 12.6 tons/Rai.

3395 Krishnapillay, D.B; Ali, A.R.M. 2000. **Site technology and productivity of teak: The Malaysian experience**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 109-122. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

Teak was introduced to Malaysia during the British colonial period. Teak shows good growth rates and financial returns in Malaysia. Distribution, ecological requirements of teak, experience with teak in Malaysia and financial feasibility of planting teak are discussed.

3396 Kudindhra, U. 1965. **Study on crown-spreads in 1-20 years old teak plantations**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Average crown coverage is estimated as 0.26m/year and age and crown spread is correlated.

3397 Kuerkool, P. 1965. **Study on the relationship of d.b.h. and root spreads of teak in teak plantations of different ages**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The study indicated no statistical relation between d.b.h. and crown spread, but between d.b.h. and root spread.

3398 Kumar, A.N.A; Srinivasa, Y.B; Chauhan, S.S. 2002. **Growth rate convergence in teak (*Tectona grandis* Linn.f.)**. Current Science 83(7): 808-809.

Rings of teak trees from three sites were collected to determine the variation in their growth pattern. From the ring widths frequency, trees were categorized into four size cohorts, very small, small, medium and large radius. The growth rates of tree cohorts showed that the cohort with large radius had the highest growth rate and the cohort with very small radius had the lowest growth rate.

3399 Kumar, B.M; George, S.J; Chinnamani, S. 1994. **Diversity, structure and standing stock of wood in the home gardens of Kerala in peninsular India**. Agroforestry Systems 25(3): 243-262.

A survey was conducted in selected thaluks of Kerala state to elucidate the floristic structure, composition and the extent of similarities and diversities in the composition of home gardens. The potential of the home gardens to supply commercial timber and fuelwood was also assessed. Farmers prefer timber trees such as teak, Ailanthus and fruit trees such as mango, jack and cashew.

3400 Kumar, B.M; Long, J.N; Kumar, P. 1995. **A density management diagram for teak plantations of Kerala in peninsular India**. Forest Ecology and Management 74(1/3): 125-131.

A density management diagram was constructed using stand inventory data from teak plantations in Western Ghats of peninsular India. The diagram's utility in predicting the consequences of stand density manipulations is illustrated for pole and log production.

3401 Kumar, P.D; Rajesh, N; Kumar, A.V.S; Vidyasagar, K; Anaz, M.A. 1997. **Crown diameter/bole diameter relationship as an aid to thinning in teak (*Tectona grandis* Linn.f.)**. Indian Journal of Forestry 20(4): 355-361.

A field study was conducted in the teak plantations of Kerala to develop thinning guidelines based on the relationship between crown diameter and bole diameter. A good correlation was demonstrated between crown diameter and bole diameter and the teak trees were shown to use space more efficiently with increase in size.

3402 Kushalappa, K.A. 1984. **Commercial productivity of Kanara forests, Karnataka**. Indian Forester 110(7): 644-654.

An account is given of materials and revenue obtained from fellings in the natural forests and from thinnings in teak plantations.

3403 Kyi, Maung. 1963. **Two critical problems currently facing teak yield regulation and some practical suggestions**. Burmese Forester 13(1): 6-13.

Criticizes the current practice in Burma and urges the regulation of yield on a volume or basal area basis.

3404 Kyi, U. 1960. **A note on fixation and control of teak yield in Mohnyin reserve**. Burmese Forester 10(2): 101-107.

A note prepared for teaching purposes.

3405 Kyi, U. 1961. **Teak yield regulation in Burma**. Burmese Forester 11(2): 109-115.

Describes the modern outlook on yield regulation and briefly discusses the factors for consideration in the choice of yield regulation method. The development of methods of teak yield regulation in Burma is traced.

3406 Laan, E.van der. 1930. **The yield of teak plantations**. (Dutch; English). Tectona 23: 659-664.

Author compared the real output of teak plantations after cutting with Berkman's yield table for teak. The real output varied from 65 to 132 pecentage from calculated figures.

3407 Lahiri, A.K. 1996. **Pole yield of some softwood and hardwood species grown in Bangladesh**. Journal of the Timber Development Association of India 42(3): 21-24.

Growth study on nine timber species planted in Bangladesh soils revealed that six species fall under the wooden electric pole yield group-A, ie. they produce 33 percent poles within 10 years another 33 percent within 15 years and additional 33 percent within 20 years of rotation. The species include *Tectona grandis*.

3408 Lalman; Misra, A. 1981. **Dry matter production by some tropical forest tree seedlings**. Van Vigyan 19(1): 1-13.

In *Tectona grandis* there was an inverse relation between leaf and root dry weight in 0-12 month old seedlings growth. Net primary productivity of all species increased with age. Litter production was more in *Tectona grandis* than *Terminalia arjuna*.

3409 Latif, M.A; Khan, A.F.M.K; Hossain, M.M. 1998 . **Stump diameter-dbh-volume relationships for teli garjan (*Dipterocarpus turbinatus*), dhakijam (*Syzygium grande*) and teak (*Tectona grandis*) in Bangladesh**. Bangladesh Journal of Forest Science 27(1): 16-24.

Diameter at breast height and diameters at stump heights were measured for standing trees of teak along with other trees in plantations in Bangladesh. Equations are given for stump diameter-dbh relationships.

3410 Laurie, M.V; Ram, B.S. 1940. **Yield and stand tables for teak (*Tectona grandis* Linn.f.) plantations in India and Burma**. Indian Forest Records (n.s.) Silviculture 4-A(1): 115p.

This is the first attempt at a comprehensive yield table for teak plantations throughout India and Burma. A table of top height by site quality and age, stand tables, espacement tables by age and site quality and by average crop and various stand data are also included.

3411 Lin, T.Y. 1975. **A method for prediction of yield on the unstocked land or cut-over area for silviculturing**. (Chinese). Quarterly Journal of Chinese Forestry 8(3): 1-24.

Describes how multiple regression analysis may be used to predict site quality from site factors. Provisional yield tables are presented for three site classes in Taiwan. It is suggested that the method may be used to select suitable areas and tree species for silviculture.

3412 Liu, S.H; Hung, L.B. 1950. **Studies on the increment of teak in coppice forest and of planted trees (*Tectona grandis* Linn.f.)**. (Chinese). Bulletin of Taiwan Forest Research Institute 22: 24p.

Measurements were made for 2 to 3-year-old coppice from trees felled at 30 years. Measurements of planted trees were made by stem analysis on 8 wind-thrown trees.

3413 Lizano, M.H.C; Salazar, R. 2000. **Evaluation of teak and *Gmelina* plantations in the Huetar Norte region in Costa Rica for use as seed stands**. (Spanish). II Simposio sobre avances en la produccion de semillas forestales en America Latina: Memorias, Santo Domingo, Republica Dominicana, 18-22 de octubre, 1999: 61-63. Centro Agronomico Tropical de Investigacion y Ensenanza (CATIE), Turrialba Costa Rica.

An evaluation of twelve teak and *Gmelina arborea* plantations was carried out. Evaluation parameters of diameter at breast height, trunk shape and number of trees/ha have been included.

3414 Lopez. 1932. **Growth of teak in Brazil**. Tropical Woods 32: 33p.

3415 Lugo, A.E; Brown, S; Chapman, J. 1988 . **An analytical review of production rates and stemwood biomass of tropical forest plantations**. Forest Ecology and Management 23(2/3): 179-200.

Data on stemwood biomass and mean annual biomass increment for seven tropical tree plantation species including *Tectona grandis* were synthesized from the literature to evaluate species adaptability and potential yields in different environments. Stemwood biomass and MABI varied with species, plantation age, and climate. Linear models described the relationship between stemwood biomass and age of plantation.

3416 Lushington, P.M. 1895. **Rate of growth of teak**. Indian Forester 21(1): p56.

Gives dimensions of teak trees in a 19 year old plantation in Nilambur.

3417 Malende, Y.H; Temu, A.B. 1990. **Site index curves and volume growth of teak (*Tectona grandis*) at Mtibwa, Tanzania**. Forest Ecology and Management 31(1/2): 91-99.

Height curves for 4 site indices at age 20 yr are compared with those from Nigeria, C. America, Java and India. It is predicted that rotation age of 60 yr will yield approximately 600 m3/ha of wood.

3418 Mammen, C. 1998. **Teak plantations in Nilambur: An economic review**. KFRI Research Report 144: 71p. Kerala Forest Research Institute, Peechi.

Analysed the productivity and profitability of teak plantations in Nilambur, Kerala. Yield data were collected for the period 1967-94 from an area of 12 500 ha. The mean yield in a rotation of 53 yr was 151 m3 ha-1. The average yield is reported correspond to that of site quality IV. The average site quality was far below that of the lowest class. It is suggested that careful analysis is required to specify the magnitude of deterioration and the reasons for this.

3419 Marsden, R.E. 1908. **The effect of aspect on the growth of teak**. Indian Forester 34(10): 592-593.

Gives the average increment of teak on different aspects in Myittha Forest Division, Burma. The best aspect for teak in these forests appears to be a north-westerly one and the next best a northerly one while the worst is an easterly aspect.

3420 Mathauda, G.S. 1954. **Relationship between the average diameters of the main and the subsidiary crops in the case of plantation teak (*Tectona grandis* Linn.f.)**. Indian Forester 80(11): 707-708.

Average diameters of thinnings were plotted against those of main crop, for 4 site qualities and 2 grades of thinning. The distribution of points indicated that the relationship is independent of both site quality and thinning grade within the range of C and D grades of ordinary thinnings.

3421 Mathauda, G.S. 1955. **The constitution and rate of growth of a tropical moist deciduous forest in South Chanda Division, Madhya Pradesh**. Indian Forester 81(10): 604-619.

It is shown that like the tropical wet evergreen Ghat forests, balanced uneven aged crops belonging to the moist deciduous forest type obey the law of de Liocourt. The basal area and volume per acre of the growing stock and their rates of growth have been determined and compared with those resulting in the tropical wet evergreen type and teak and sal even aged crops of comparable site quality. The average rates of diameter growth of the 17 commonest tree species have been determined and are presented.

3422 Mauricio, J.R; Vincent, L; Moret, A.Y. 1999. **A competition model for the teak plantations in the experimental area of the Caparo Forest Reserve (Barinas-Venezuela)**. (Spanish). Revista Forestal Venezolana 43(2): 157-171.

The crown diameter - diameter at breast height relationship was fitted to a potential model, using non-linear regression.

Periodic increments in dbh were predicted using linear and non-linear regression with Bella's model functions as explanatory variables. The non-linear model was the best predictor for 3-year periodic increments in dbh.

3423 Mein, A.J. 1885. **Dimensions of a teak tree**. Indian Forester 11: p376.

Gives the growth figures of a teak tree sown at Kulsi, Assam in 1874 and cut down in 1885.

3424 Mendoza, B; Alfonso, M; Fuenttes, D; Hugo, V. 1996. **Report of five years of growth of mahogany, cedar and teak in a plantation of Tezonapa, Veracruz**. Proceedings of Scientific and Technological Meeting of Forestry, Agriculture and Husbandry, Mexico 1996: 38-39.

3425 Miller, A.D. 1969. **Provisional yield tables for teak in Trinidad**. Government Printer, Trinidad and Tobago: 12p.

Yield table is provided of the Trinidad teak plantations for over 50 years. The method used in compiling the tables are described. The tables prescribed thinning regimes which are heavier than those currently practised and there is a discussion on how this may help to reduce site deterioration due to fires and erosion. The question of planting spacing is discussed and economic factors are mentioned.

3426 Miller, W.A. 1916. **Complete volume analysis of teak from Kirwatti jungles**. Indian Forester 42(8): 420-424.

Volume and increment have been worked out for these forests of teak. The author is of the opinion that the selection system that followed is most unsuited to these forests. Suggested a rotation of 80 years. He concludes the present high forest system is unsuitable and full limit of working is not reached. He recommends even-aged forest conversion under uniform system.

3427 Mohya, T. 1966. **Study on the correlation of width of crown, dbh and height of teak in 6-20 year old plantations**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Crown diameter, d.b.h. and height are correlated to their age.

3428 Moor, H.W. 1922. **Rate of growth of teak for Trinidad**. Indian Forester 48(11): 614-615.

Commenting on exotic origin of teak in Trinidad - 9 years ago, teak is considered faring well, under exotic conditions-except for a single reported case of boring by an unidentified beetle which has lead to a secondary attack by the fungus. Tabulated the data of growth which indicate girth and height of plantations.

3429 Mora Garces, A; Moret, A.Y. 2001. **An evaluation of estimation methods to fit volume equations for teak (*Tectona grandis* Linn.f.) plantations**. (Spanish). Revista Forestal Venezolana 45(2): 185-189.

A free distribution estimation method, non-linear estimation and Least squares were used to fit data from 174 trees selected by stratified sampling, considering diameter classes as strata. The results suggest that the simple allometric model can be estimated by nonparametric methods, Theil and Least square with log transformation in data.

3430 Morataya, R; Galloway, G. 1998. **Relationships between foliage and sapwood in *Tectona grandis* and *Gmelina arborea*: Applicability of the Pipe Model Theory and silvicultural implications**. Revista Forestal Centroamericana 7(22): 21-28.

This study demonstrates the importance of thinning by examining the relationships between sapwood and foliage biomass in *Tectona grandis* and *Gmelina arborea* and evaluating the applicability of the Pipe Model Theory to these species. The Pipe Model Theory was found to be applicable to both species. The results indicate that it is important to favour tree crown development without permitting premature crown recession if the aim is to produce saw timber in established stands.

3431 Morataya, R; Galloway, G; Berninger, F; Kanninen, M. 1999. **Foliage biomass-sapwood (area and volume) relationships of *Tectona grandis* Linn.f. and *Gmelina arborea* Roxb: Silvicultural implications**. Forest Ecology and Management 113(2/3): 231-239.

Foliage biomass and sapwood relationships were developed for *Tectona grandis* and *Gmelina arborea* growing in the Guanacaste province of Costa Rica. Strong linear relationships confirmed the applicability of Shinozaki's pipe model theory to both of these species. The relationships between foliage biomass and sapwood area and volume of the previous year's growth ring were also analysed and were found to be highly significant for *T. grandis*.

3432 Moret, A.Y; Jerez, M; Mora Garces, A. 1998. **Development of volume equations for**

plantations of teak (*Tectona grandis*) in the Experimental Unit of Caparo Forest Reserve, Barinas, Venezuela. (Spanish). Revista Forestal Venezolana 42(1): 41-50.

Fifteen regression models were developed using data from 174 trees, selected by stratified random sampling for diameter class, in order to obtain volume equations for teak plantations in Venezuela.

3433 Mungkorndin, S. 1968. **Teak yield regulation**. Master's Report, Colorado State University, Colorado: 57p.

3434 Murugesh, M; Balaji, B; Krishnan, S.R; Srinivasan, V.M; Balaji, S. 1998. **Use of linear measurement in the estimation of leaf area of teak (*Tectona grandis* Linn.f.)**. Indian Journal of Forestry 21(4): 363-365.

A method is described for estimating the leaf area of teak using the product of length and breadth multiplied by a constant. The value of the constant was derived by dividing the actual leaf area by length and breadth.

3435 Murugesh, M; Srinivasan, V.M; Rai, R.S.V; Balaji, S. 1997. **Growth and yield of teak (*Tectona grandis* Linn.f.) under irrigated condition**. Indian Journal of Forestry 20(4): 373-376.

A study was carried out in Tamil Nadu on the growth and yield of teak in three irrigated woodlots at different sites. Data are tabulated on growth parameters and current annual increment and mean annual increment for dbh and height at each age. Based on this, the volume at 20 yr is extrapolated to be 7.00 ft3/tree.

3436 Nadagouda, V.B; Patil, C.V; Desai, B.K; Manjappa, K. 1997. **Growth and yield of seven tree species under high density planting and irrigation**. Indian Forester 123(1): 61-65.

The performance of seven tree species including *Tectona grandis* under high density planting was evaluated on irrigated red sandy clay loam soils in Karnataka. At the end of the fifth year, *Tectona grandis* had the lowest wood yield of 28.1 t/ha.

3437 Nair, C.T.S. 2000. **An introduction to technology and productivity issues**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 1-10. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

Broad features of identified production systems i.e., natural forests, plantations and small scale plantings especially in homegardens and small woodlots are discussed. The variation of each system from country to country and the history of its management are discussed. The spatial and temperal changes in teak planting are also summarised. Impact of technology on productivity of teak plantations and marketing and utilisation of teakwood in different production systems are discussed. Objectives of the International Seminar on site, technology and productivity of teak plantations are also discussed.

3438 Nataraja, K.N; Arun Kumar, A.N; Srivastava, A. 2003. **A non destructive method for estimation of leaf area in nursery grown teak (*Tectona grandis* Linn.f.) seedlings**. Annals of Forestry 11(1): 94-97.

3439 National Taiwan University. 1974. **Growth records of important species in the Experimental Forest, College of Agriculture, National Taiwan University**. (Chinese). Experimental Forest of National Taiwan University 4: 473p.

Tabulated data from permanent plots in plantations including *Tectona grandis* of Central Taiwan of stand increment and yield and of very detailed stem analyses at different ages are presented.

3440 Nayak, P.K; Senapati, S.C. 1998. **Evaluation of tree species under various plant geometry**. Environment and Ecology 16(2): 382-384.

In a field experiment in Orissa, 6-month-old seedlings of *Tectona grandis* and other species were planted at different spacings. Tree height was found the highest with the close spacing of 1 m X 1 m, while girth at breast height was the highest with the wide spacing of 4 m X 2 m, in all the species.

3441 Negi, G.S. 1967. **The accuracy of basal area increment with increment borer**. Indian Forester 93(6): 377-382.

It is estimated that the precision and accuracy of basal area increment based on borings varied with the tree species including teak.

3442 Negi, J.D.S; Bahuguna, V.K; Sharma, D.C. 1990. **Biomass production and distribution of nutrients in 20 years old teak (*Tectona grandis*) and gamar (*Gmelina arborea*) plantations in Tripura**. Indian Forester 116(9): 681-686.

Estimates based on the mean tree technique are presented from teak and *Gmelina arborea* plantations that had been established on land reclaimed from shifting cultivation. Average tree density, diameter, height and mean annual increment are presented. Total above-ground biomass and annual productivity for both the species are also presented.

3443 Negi, M.S; Dhiman, R.C. 2000. **Biomass estimation of teak plantation from Terai Region of Uttar Pradesh**. Indian Journal of Soil Conservation 28(2): 151-159.

Results of a study conducted in teak plantations in Uttar Pradesh in observing growth and biomass parameters of height, diameter at breast height (dbh) and volume of mean tree, are presented and discussed. Regression equations were developed for predicting biomass and growth of different tree components based on age and dbh.

3444 Negi, M.S; Tandon, V.N; Rawat, H.S. 1995. **Biomass and nutrient distribution in young teak (*Tectona grandis* Linn.f.) plantations in Tarai region of Uttar Pradesh**. Indian Forester 121(6): 455-464.

Estimates of dry matter production and nutrient distribution in 10-, 20- and 30-yr-old teak plantations are made using linear regression analysis. It is found that the diameter at breast height gave reasonably precise values of biomass and can be used for prediction purposes. The total standing biomass of the stands increased with increasing age and diameter.

3445 Neumann, A; Neumann, A.J. 1988. **Compendium of Solomon Island volume equations for plantation species**. Forestry Division, Solomon Islands, Forest Research Note 41-9-88: 14p.

Equations based on data collected from felled trees and relascope measurements are summarized for seven species including *Tectona grandis*.

3446 Nguyen Hoang Nghia; Booth, T.H. 1996. **Current methods and future needs for tree growth prediction in Vietnam**. Matching trees and sites: Proceedings of an International Workshop, Bangkok, Thailand, 27-30 March 1995: 65-67; ACIAR Proceedings 63. Australian Centre for International Agricultural Research, Canberra, Australia.

The VIET climatic mapping program is suggested for finding where particular species and provenances can grow. The paper includes data on the growth of species including *Tectona grandis* at sites in Vietnam, in relation to soil and water requirements.

3447 Nimitsiriwat, S. 1966. **Comparison of the measurement of dbh of teak using different instruments**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The efficiency of different instruments used for measuring diameter at breast height are compared which are of caliper, diameter tape, Biltmore stick and Bitterlich caliper.

3448 Nisbet, J. 1898. **On largest logs of teak**. Indian Forester 24: p320.

The log cut from Shweli forests was of 82 ft. length, basal girth of 12-13 ft. and top girth of 7-8 ft. and a volume of 516 cft.

3449 Nunifu, T.K; Murchison, H.G. 1999. **Provisional yield models of teak (*Tectona grandis* Linn.f.) plantations in northern Ghana**. Forest Ecology and Management 120(1/3): 171-178.

The paper presents the results of a preliminary investigation into the growth and yield of teak in northern Ghana. Data were collected from plots from plantations ranging in age from 3 to 40 yr, are used to develop a standard volume equation, site index curves and provisional empirical yield tables.

3450 Nwoboshi, L.C. 1983. **Growth and nutrient requirements in a teak plantation age series in Nigeria. 1. Linear growth and biomass production**. Forest Science 29(1): 159-165.

Linear dimensions and aboveground biomass accumulation and distribution were measured for 40 trees of age 1-5 yr. Variations in average dbh, height, basal area, volume, leaf area index, diameter production, rate of biomass accumulation and leaf biomass with age are studied. It is recommended that thinning should be started in 9- to 11-yr-old stands, when LAI reaches about 4.5.

3451 Ola-Adams, B.A. 1974. **Estimation of biomass and productivity of some natural forests and plantations in** Nigeria**.** Nigerian Journal of Forestry 4(1): 18-23.

Data estimated from measurements of wood volume and oven-dry specific gravity are presented. Estimated values for biomass of natural forests, forest plantations including teak and savanna plantations are given. The estimated mean annual accumulations of organic matter for forests and savanna plantations are also given.

3452 Ola-Adams, B.A. 1997. **Assessment of three allometric regression techniques of biomass determination in two hardwood species**. Journal of Tropical Forest Science 9(3): 321-328.

Biomass estimations using three allometric regression equations with different independent variables were carried out in 18-yr-old *Tectona grandis* plantations established at SW Nigeria.

3453 Oliver, J.W. 1882. **Rate of growth of teak in Burma**. Indian Forester 9: p440.

Compares the true and false rings occurring on teak and concludes that true growth rings are annual.

3454 Oza, M.P; Srivastava, V.K; Devaiah, P.K. 1992. **Estimating the mean canopy diameter of teak plantations from Landsat MSS data**. International Journal of Remote Sensing 13(12): 2363-2369.

An attempt has been made to estimate mean canopy diameter in managed even-aged teak plantations in Karnataka using Landsat-4 Multispectral Scanner data. Mean canopy diameter of plantations of different ages ranging from 4 to 63 yr were measured. Variables entering regression equations were selected by the leaps and bounds technique.

3455 Pandey, D. 1983. **Growth and yield of plantation species in the tropics**. FAO, Rome.

3456 Pandey, D. 1996. **Estimating productivity of tropical forest plantations by climatic factors**. Rapport Institutionen for Skoglig Resurshushallning och Geomatik, Sveriges Lantbruksuniversitet 7: 82p. Institutionen for Skoglig Resurshushallning och Geomatik, Department of Forest Management and Geomatiks, Swedish University of Agricultural Sciences, Sweden.

The study reviews the existing approaches available for estimating growth and yield of plantation species in the tropics. A generic model is formulated for estimating potential yield of plantation species in the tropics using climatic variables. The quantitative relation between individual climatic variables and potential yield of plantation teak was studied.

3457 Pandey, D. 1996. **Tropical forest plantation resources: Assessment of extent and methods for yield estimation**. Acta Universitatis Agriculturae Sueciae Silvestria 11: 47p. Swedish University of Agricultural Sciences, Umea, Sweden.

The role of tropical forest plantations in economic development and in reversing deforestation in tropical countries is discussed. The development of plantations over time is described and the general trend in tropical plantation forestry in recent years is critically analysed. A generic model for estimating potential yield by climatic factors was developed using teak. Recommendations for realising the potential value of tropical plantations and future assessment are presented.

3458 Pandeya, S.C; Kuruvilla, K. 1967. **Net production relations of five important tree species at Waghai range of Dangs forests, Gujarat**. Proceedings of Indian Academy of Sciences 66B(1): 25-36.

It is found that stem volume, gbh, total dry weight and height are directly proportional to number of growth rings, total dry weight increases with increasing g.b.h., distribution of net annual productivity shows increasing concentration of growth in woody tissues with increasing plant size in species including *Tectona grandis*.

3459 Perez, C.L.D; Kanninen, M. 2002. **Estimation of the commercial volume to diameters and variable heights for *Tectona grandis* Linn.f. in Costa Rica**. Revista Forestal Centroamericana 39-40: 56-59.

Volume equations which predict individual tree volume and merchantable volume for teak in Costa Rica is tested.

3460 Petekhandah, S. 1965. **Study on the relationship of crown widths and root spreads of teak in teak plantations of different ages**. (Thai). Student Thesis. Kasetsart University, Bangkok.

No relationship was observed between crown spread and root spread in teak plantations of 1-20 years age observed.

3461 Petmark, P; Sahunalu, P. 1978. **Primary production of teak plantations. I. Net primary production of thinned and unthinned plantations at Ngao, Lampang**. (Thai). Faculty of Forestry, Kasetsart University, Forest Research Bulletin 53: 76p.

Data on above ground biomass, net primary production, stem volume increment and leaf efficiency in production from 14-yr-old stands thinned at 8 yr old by removing 45 percent basal area is given.

3462 Phang-Sono. 1977. **Study on teak stumps to ascertain volumetric index for duty collection**. (Thai). Vanasarn 35(4): 451-463.

3463 Phillips, G.B. 1995. **Growth functions for teak (*Tectona grandis* Linn.f.) plantations in Sri Lanka**. Commonwealth Forestry Review 74(4): 361-375.

The paper briefly reviews the current practices in teak silviculture in Sri Lanka and outlines the need for growth and yield models. Describes the development of growth functions for dominant height and cumulative basal area and a growth and yield model developed using the Excel spreadsheet.

3464 Phong-Amphai, S. 1965. **Study on the growth of teak in the teak plantations of Lampang and Nakorn, Rajsima**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The growth of teak plantation of Klangdong and Mae Huad are compared.

3465 Phukphan, S. 1965. **Increment of teak of different qualities**. (Thai). Student Thesis. Kasetsart University, Bangkok.

There is least significant difference in diameter growth and girth of teak in different quality sites.

3466 Pinol, A.A. 1994. **Yield prediction models for teak (*Tectona grandis* Linn.f.)**. Sylvatrop 4(1): 65-80.

Yield prediction functions for both merchantable and sawn timber yield for teak plantations were derived from plots by regression analysis. The plots represented a wide range of site qualities, stand densities and ages of teak in the Philippines. A site index guide equation and plot site index equation at 40-years base age were developed.

3467 Pongsopha, Ch. 1965. **Study on the productivity of teak in 20 years old teak plantation**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The study establishes a significant correlation between d.b.h. stem weight, branch weight, leaf weight and whole tree weight.

3468 Powell, W.S. 1923. **Note on the growth of teak and teak plantations in Arakan Burma**. Burma Forest Bulletin (Silviculture) 8: 1-43.

Financial results obtained indicate profitability of growing teak plantations. Taungya method was followed in later plantation to reduce costs.

3469 Prasad, R; Mishra, G.P. 1984. **Standing biomass of various plant parts in selected tree species of dry deciduous teak forest in M.P**. Indian Forester 110(8): 765-782.

An investigation was made in the teak forests in Madhya Pradesh, to correlate their biomass productivity with various plant parameters and age, utilizing wind-fallen teak trees and felled trees of other species. The crown, stem, and root biomass of these species is tabulated against girth and age.

3470 Prasoon Kumar; Mohan Kumar, B. 1997. **Density management diagram - a novel approach in stand density manipulation of teak plantations**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 61-67. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

A density management diagram to predict and display the likely consequences of teak stand manipulation on stand growth and yield was constructed using the inventory data collected from the teak plantations of Kerala. Use of this diagram in maximization of individual tree growth and stand growth is also demonstrated.

3471 Prertiwarakul, L. 1968. **Correlation of growth between crown diameter and width of annual rings of teak of different age classes at Huay-Tak teak plantation, Lampang**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Teak plantations of 5, 10, 15 and 20 years were studied and found that the increment of crown diameter and width of annual rings are significantly correlated with the periods.

3472 Priya, P.B. 1998. **Growth periodicity and juvenile wood formation in teak**. Ph.D Thesis: 154p. Forest Research Institute, Deemed University, Dehra Dun.

3473 Prommool, S. 1962. **The correlation between crown diameter and dbh, crown diameter and height and dbh and height of teak at Mae Huad forest, Lampang**. (Thai). Student Thesis. Kasetsart University, Bangkok.

A significant correlation was observed in natural forest between crown diameter, height and dbh in the study.

3474 Purwanto, R.H; Oohata, S. 2002. **Estimation of the biomass and net primary production in a planted teak forest in Madiun, East Java, Indonesia**. Forest Research, Kyoto 74: 59-68.

The biomass and productivity of planted teak forests in old stands of 10- to 40-year-old were estimated and compared with those of young stands. The allometric relationships of various dimensions of individual trees e.g. stem diameter at breast height and stem diameter at the lowest branch DB were estimated. The productivity was estimated using the biomass increment and leaf production.

3475 Raghavan, M.S. 1946. **Constants connecting top heights and age for different site qualities in teak plantations**. Indian Forester 72(10): 460-461.

A formula is shown to define the height age curvilinear relationship in the yield table for plantation teak.

3476 Rajkhowa, S. 1970. **The shape of a teak tree**. Indian Forester 96(1): 719-731.

Relations of tree height, tree diameter and crown spread were calculated for *Tectona grandis* of three quality classes. Regression equations for estimating bole diameter and equations relating bole diameter to tree height and crown spread are tabulated, and their degrees of fit are estimated for the three quality classes.

3477 Ram, B.S. 1942. **Standard and commercial volume tables for teak (*Tectona grandis*, Linn. F.) in the Central Provinces**. Indian Forest Records (n.s.) Silviculture 4-A(3): 145-169.

Volumes calculated by basal-area and quarter-girth measurements are given for various diameter and height and girth and height classes.

3478 Rao, R.V; Shashikala, S. 2003. **Assessment of growth rate, basic density and heartwood content in selected teak clones of CSO, Thithimathi, Karnataka**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

An attempt was made to generate data and understand the variation in wood quality in individual trees which can be used subsequently for the purpose of selection for seed collection as well as mass propagation. Trees representing clones from Haliyal, Thirthimathi, Shimoga, Kakanakote, Nagarahole and Bhadravathi were subjected for investigation.

3479 Ratanakoses, S. 1964. **Correlation between basal area and age of teak in Huay-Tak teak plantations of different age classes**. (Thai). Student Thesis. Kasetsart University, Bangkok.

A correlation was found in the study between age class of 5-20 years and basal area.

3480 Rawat, A.S. 1954. **Mathematical equation for determining the stem timber form factor of *Tectona grandis***. Indian Forester 80(9): 513-521.

A formula has been worked out for determination of form factor of *Tectona grandis* trees of different dimensions and age growing under different locality conditions to provide a method by which volume of standing trees can be estimated from the measurements of dbh and tree heights.

3481 Reddy, C.J. 1995. **The bounty from the teak tree**. Indian Forester 121(6): 573-575.

A brief discussion of the very high potential growth rates of teak plantations in India and of their profitability and wood quality.

3482 Renes, G.J.B. 1978. **An investigation of yield and productivity of teak plantations in South-Western Nigeria**. Federal Department of Forestry, Ibadan, Nigeria.

3483 Rodger, A. 1923. **The biggest teak log ever brought out from the forests of Burma**. Indian Forester 49(2): p80.

Reports of a big teak log extracted from Shweli Valley, Ruby mines district, Burma is having the size of 82.5 feet long, 10' in mid girth with 391 cft.

3484 Rogers, C.G. 1918. **Big teak in Burma**. Indian Forester 44(9): 416-419.

An account of the site factors such as geology, rock and soil, rainfall, character of the vegetation and altitude is given. Dimensions of five big trees are also given.

3485 Ross, J.K. 1954. **Yield of poles and fuelwood from Olokemeji reserve plantations (10 years rotation-coppice regeneration)**. Information Bulletin of Forest Department, Nigeria 14(2/3).

Included mainly teak.

3486 Roy, P.S; Singh, I.J; Das, K.K; Sharma, C.M; Hyderi, S.A. 1996. **Growing stock estimation of monoculture plantations using remote sensing techniques and a geographical information system - a case study in central Tarai Forest division, U.P**. Proceedings, IUFRO-DNAES International Meeting: Resource inventory techniques to support agro forestry and environment, Chandigarh, 1-3 October 1996: 73-83. B.K. Quershi; R.K. Kohli; K.S. Arya; Atul, Eds. HKT Publications, Chandigarh.

Results are given of a case study carried out in the Central Tarai Forest Division of Uttar Pradesh using inventory data, Landsat Thematic mapped data and a geographical information for the area. The area is mainly consist of teak plantation with some mixed plantations.

3487 Rugmini, P; Balagopalan, M. 2001. **Growth of teak in successive rotations: A case study at Nilambur, Kerala, India**. Tropical Forestry Research: Challenges in the New Millennium. Proceedings of the International Symposium, Peechi, India, 2-4 August 2000. R.V. Varma; K.V. Bhat; E.M. Muralidharan; J.K. Sharma, Eds: 192-194. Kerala Forest Research Institute, Peechi.

A study on growth of teak in successive rotations was carried out at Nilambur, Kerala. The decrease in tree height and dbh from first rotation to later rotations and from plain lands to hilly terrain for plantations of same age and stocking indicated loss of tree vigour with successive rotations and sloping terrains.

3488 Sagreiya, K.P. 1956. **Brandis' method of yield regulation**. Indian Forester 82(6): 271-285.

Gives a mathematical analysis of Brandis' system, applies it to a Madhya Pradesh forest containing 25 percent teak.

3489 Sagreiya, K.P. 1958. **Fixation of the yield of an irregular forest on the basis of its current annual increment**. Indian Forester 84(4): 213-215.

Deals with the comparative merit of the author's method and Sahai's method of calculation with reference to Smythies' formula in determining the correct yield.

3490 Sagreiya, K.P. 1963 . **Single stem silviculture (height/spacing relationship)**. Indian Forester 89(10): 652-656.

Discusses criticisms of the author's proposal to use the normal N/D correlation of teak in determining thinning schedules and proposes instead the relationship of stand density to height.

3491 Sagreiya, K.P; Chacko, V.J. 1962. **A statistical approach to models for yield tables in even aged teak forests and some applications**. Indian Forester 88(12): 896-906.

Site quality index for even-aged teak forests based on top height is defined, and a method of determining the site quality is explained. Three equations giving the top height corresponding to a site quality and age, normal diameter corresponding to a top height, and normal number of trees per acre given the mean diameter are presented. These three equations summarize the yield table for even-aged teak forests.

3492 Saing, T.K. 1928. **Biggest Teak tree in Burma**. Indian Forester 54(7): 423-424.

Reports log yield from a big teak with girth at base 29'3" at 4.5'-25'11" on felling and 26'7" at girdling time, yielded over 14 logs of 1367 cft.

3493 Samantakul, V; Songkul, S. 1995. **Teak resources in Thailand. Teak for the future**. Proceedings of the 2nd Regional Seminar on Teak, Yangon, Myanmar, 29 May-3 June 1995.

3494 Samapudhi, K. 1966. **Forestry development in Thailand**. Royal Forest Department, Bangkok: 39p.

A general note on forests, forestry, management, policy wildlife, National parks and administration etc. The forests area managed for teak extraction in Thailand is 115, 632 sq.km. and teak plantation raised and old giant teak logs extracted are illustrated.

3495 Samranchit, T. 1964. **Comparison of the Survival percentage and growth of teak in the second year from plants resulting from special problem No. 75, 86 and 89**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Height growth and survival of stump with roots is found better than those without roots. Expenditure of stumps without root is found also higher. Stored stumps are better than fresh ones. Height growth of unforked stump is found better than forked stumps, but survival of forked stumps is better.

3496 Sandrasegaran, K. 1966. **Provisional local volume tables for teak (*Tectona grandis* Linn.f.)**. Malaysian Forester 29(1): 39-40.

The data from Perlis, N.W. Malaya gives in cubic feet fuel tree volume and total small wood volume.

3497 Sandrasegaran, K. 1969. **A general volume table for *Tectona grandis* Linn.f. (teak) grown in north-west Malaya**. Malaysian Forester 32(2): 187-200.

A volume table is given based on a multiple regression analysis by computer of more recent data, with an account of the statistical method.

3498 Santhadkaran, P. 1964. **Percentage of well formed trees found in various age classes of Mae Huad teak plantation, Lampang**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The well formed tree percentage was reported as between 58 to 83 which is highly variable.

3499 Shende, N.V; Atkar, R.B; Shende, T.K. 1998. **Resource productivity and input use efficiency of major forest crops grown by farmers under Akola district**. Economic Affairs Calcutta 43(1): 28-32.

Examined the productivity and efficiency of inputs used in production by applying a Cobb-Douglas production function equation. Variables examined are tree crop yield, area under the crop, human labour days, bullock labour days, value of seedlings, expenditure incurred on manures and fertilizers, irrigation on plantation, expenditure on plant protection.

3500 Shirley, G.S. 1928. **Volumes of single trees and volume and number of trees per acre from data collected in teak (*Tectona grandis*) plantations in Burma**. Burma Forest Bulletin 17 (Silviculture Series 13).

3501 Shirley, G.S. 1932. **Rate of growth of teak in Burma**. Annual Report of Working Plans etc, Burma: p52; 54.

3502 Singh, A.K. 1978. **Comparison of primary productivity and energetics of Savanna and teak (*Tectona grandis* Linn.f.) plantations at Chandraprabha Region, Varanasi**. Thesis. Banaras Hindu University, Varanasi.

3503 Singh, A.K; Gupta, B.N. 1993. **Biomass production and nutrient distribution in some important tree species on Bhata soils of Raipur (Madhya Pradesh), India**. Annals of Forestry 1(1): 47-53.

Biomass production and nutrient distribution in the different components of six tree species including *Tectona grandis* were studied in plantations of different ages. Nutrient content was higher in the leaves and lower in the roots of all species.

3504 Singh, A.K; Pandey, V.N; Misra, K.N. 1980. **Stand composition and phytomass distribution of a tropical deciduous teak (*Tectona grandis*) plantation in India**. Journal of the Japanese Forestry Society 62(4): 128-137.

Measurements of girth at 1.3 m. height, crown circumference and length, density and basal area were made in five permanent plots. A phytosociological study of the ground vegetation was made. Biomass was estimated in the tree layer by felling 3 trees from each girth class and excavating the underground parts. Significant correlations were found between logarithmic values of girth and of other measurements like height, crown length and circumference and total tree biomass.

3505 Singh, M.M. 1967. **Growth of teak in Nilambur and Wynaad divisions, Kerala State and applicability of yield tables**. Proceedings of the 11th Silvicultural Conference, Dehra Dun, 1967 Item II. Forest Research Institute, Dehra Dun.

The growth from sample plots in Nilambur and Wyanad divisions of Kerala state is studied. It is found that the crops in Nilambur Division are generally of 1st quality and in Wyanad of 2nd. From growth studies on sample plots the applicability of yield tables is discussed.

3506 Singh, S.B. 1981. **Linear programming for determining quantitative composition of species in a mixed plantation**. Indian Forester 107(11): 686-692.

Linear programming in conjunction with the Simplex method were used to develop a model for determining optimal species composition, growth and stumpage value of each species and constraints such as area, supply commitments and management costs.

3507 Singh, S.P. 1981. **Total tree volume table for *Tectona grandis***. Indian Forester 107(10): 621-623.

Tables of total tree standard timber volumes are given based on data for 660 trees from Madhya Pradesh, Maharashtra, Karnataka, Tamil Nadu, Kerala, Andhra Pradesh, Orissa, West Bengal and Uttar Pradesh.

3508 Singhal, P.C; Trivedi, B.K. 2001. **Comparative growth dynamics of some indigenous and exotic forest tree species**. Range Management and Agroforestry 22(1): 130-133.

The growth dynamics of seven forest tree species including *Tectona grandis* were studied in Jhansi, Uttar Pradesh.

3509 Siswamartana, S. 2000. **Productivity of teak plantations in Indonesia**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 137-144. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

Reviews teak management in Indonesia and discusses factors influencing its productivity.

3510 Soemaatmadja, S.A.S. 1982. **Correlation between age and diameter in Java's teak forests**. (Indonesian). Duta Rimba 8(53): 18-32.

3511 Soemarna, K. 1979. **The enumeration method of border plots in sampling for the estimation of standing stock of teak**. (Indonesian). Laporan, Lembaga Penelitian Hutan 314: 23p.

3512 Soemarna, K; Barizi; Nasoetion, A.H; Sudiono, Y. 1977. **Estimation of basal area and number of trees in teak (*Tectona grandis*) stands**. (Indonesian). Forum, Sekolah Pasca Sarjana, Institut Pertanian Bogor 1(2): 17p.

A study of sampling methods in two 40- to 50-yr-old stands showed that the best method was plot sampling.

3513 Sono, P. 1967. **A remarkable growth of teak grown in Eastern Thailand**. Vanasarn 25(4): 285-288.

Teak is considered as a fast growing species based on growth data studies, especially when planted in Eastern Thailand, it is hoped to give good economic returns.

3514 Sono, P. 1975. **Exploitable girth limit for teak**. Vanasarn 33(2): 151-159.

Presents two growth curves for natural *Tectona grandis* in Thailand and gives sociological, economic and technological reasons for concluding that the present girth limit of 213 cm should be reduced to 150 cm.

3515 Sono, P. 1975. **Sono method of analysis for teak growth in Thailand**. (Thai). Vanasarn 33(4): 389-397.

3516 Sono, P. 1978. **Growth rate of teak in Huai Thak Plantation, Ngao, Lampang Province as determined by stump analysis for teak reforestation in 1978**. (Thai). Proceedings of the 1978 National Forestry Conference: 146-155. Royal Forest Department, Ministry of Agriculture and Cooperatives, Bangkok.

3517 Soonyakhanit, S. 1963. **Correlation between diameter, bark thickness and sapwood thickness at breast height of teak**. (Thai). Student Thesis. Kasetsart University, Bangkok.

A measurement of diameter, bark thickness and sapwood thickness at breast height of dominant, codominant, intermediate and suppressed classes of each 25 trees, gave a highly significant correlation between diameter and bark thickness.

3518 Sowani, M.Y; Gadkari, R.K. 1977. **Yield and stand tables for plantation teak (*Tectona grandis* Linn.f.) in metric units**. Maharashtra Forest Records (Silviculture) 1. Forest Development Corporation of Maharashtra, Nagpur.

3519 Sprinz, P.T. 1974 . **Form class, standard and local volume tables for teak (*Tectona grandis*) in Ghana**. Forest Products Research Institute, Ghana, Technical Note 20: 53p.

3520 Srivastava, V.K; Rai, A.M; Dixit, R.K; Oza, M.P; Narayana, A; Murty, E.S. 1998. **Significance of tree crown diameter in forest mensuration**. Indian Forester 124(12): 1001-1009.

Data collected from teak and sal plantations and natural forests shows that mean crown diameter is significantly correlated with mean tree volume. Regression equations were developed for the relationship and their predictive performance was evaluated.

3521 Stoutjesdijk, J.A.J.H. 1925. **Comparison of yield table data on teak in British India and the Netherlands East Indies**. (Dutch; English). Tectona 18: 1043-1075.

Bourne's yield tables for Nilambur teak are compared with that of Beekman for Margasri, Central Java. Age of sample plot used for both, but Bourne used top height, while Beekman used mean height. The low number of stems at 40 years in Nilambur is attributed to heavier thinnings. Stem wood and crown wood comparisons are also made.

3522 Stoutjesdijk, J.A.J.H. 1927. **Volumetric tables for natural teak forests**. (Dutch; English). Tectona 20(9): 729-780; Korte Meded Proefsta Boschw, Buitenzorg 13: 1-54.

3523 Subramanian, K; Mandal, A.K; Rambabu, N; Mammen, C; Nagarajan, B. 2000. **Site, technology and productivity of teak plantations in India**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 51-68. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

The first teak plantations was established in 1846 and large scale commercial cultivation of teak was taken up during the 1960's. Private companies started to invest in teak plantations in India since 1990. Most plantations were raised as industrial plantations between 1950 and 1970 under the schemes of the national five year plans. Improved technologies adopted to intensify management via increased inputs and silvicultural practices to achieve higher productivity are discussed in detail. It is suggested that the productivity of teak in India can be improved by identifying seed production areas, selecting more plus trees and clonal seed orchards and hybridization programs within and between species. The transfer of desirable genes for particular traits can increase productivity.

3524 Sudarmo, M.K. 1957. **Mensuration, yield and increment in Indonesia**. FAO/Teak Sub-Commission, Bandung FAO/TSC-57/23: 8p. FAO, Rome.

Notes on methods used for selecting and delimiting sample plots, description of trees by crown class, crown form and stem form for measurement of height diameter, basal area, volume, increment etc. are given.

3525 Sudhakara, K; Jayamadhavan, A; Wahid, P.A. 2001. **Mean tree volume and basal area in teak (*Tectona grandis* Linn.f.) as influenced by nutrient concentration of index leaves**. Tropical Forestry Research: Challenges in the New Millennium. Proceedings of the International Symposium, Peechi, India, 2-4 August 2000. R.V. Varma; K.V. Bhat; E.M. Muralidharan; J.K. Sharma, Eds: 115-119. Kerala Forest Research Institute, Peechi.

Leaf samples of teak from four site qualities at Nilambur, Kerala were analysed for foliar N, P and K concentrations to determine the critical nutrient levels. Equations were fitted to find the relationship of tree volume and basal area based on foliar nutrient concentration. The study help to get an insight into the silvicultural implications of fertilizer application.

3526 Sudheendrakumar, V.V; Nair, K.S.S; Chacko, K.C. 1993. **Phenology and seasonal growth trend of teak at Nilambur (Kerala), India**. Annals of Forestry 1(1): 42-46.

Leaf phenology and seasonal patterns of basal area increment of teak were studied in plantations protected from *Hyblaea puera* and *Eutectona machaeralis* in Karulai Range, Nilambur Forest Division. In general, flushing began in late March and was completed by late April. Most leaf fall occurred during December to February. The rate of increment of basal area followed a bell-shaped annual curve with most growth occurring in June, July, August and September. The results are discussed in relation to damage caused by *H. puera* and *E. machaeralis*.

3527 Sukwong, S. 1972. **Estimating past diameter of teak in Lampang**. (Thai). Forest Research Bulletin 20: 15p. Kasetsart University, Bangkok.

It is possible to estimate past diameter of teak with the help of tables presented in this paper. To use the table measurement at b.h. of diameter and radial wood growth for any specified period are required to calculate average annual width of rings. Tables are presented for natural forest and plantation grown teak separately and suggesting interpolation of data for use of tables wherever necessary.

3528 Sukwong, S; Kaitpraneet, W; Thaiutsa, B; Khemnark, C. 1974. **Predicting height growth of plantation teak from soil and topographic factors**. (Thai). Kasetsart Journal 8(2): 63-71.

3529 Sukwong, S; Tawee Kaewla iad. 1971. **Diameter conversion between stump and breast height for teak**. (Thai). Faculty of Forestry, Kasetsart University, Thailand, Research Note 4: 3p.

A multiple regression equation showed that there was a significant relationship between d.b.h. and stump diameter of teak in Lampang, Thailand. A method is given for determining the volume from the stump diameter.

3530 Sundarapandian, S; Chandrasekharan, S; Swamy, P.S. 1999. **Variations in fine root biomass and net primary productivity due to conversion of tropical forests into forest plantations**. Tropical Ecology 40(2): 305-312.

The changes in fine root biomass and net primary productivity following conversion of tropical forests into forestry plantations of teak and other species were studied at Kodayar in Western Ghats. The fine root biomass was significantly greater under the natural ecosystems compared to that of the monoculture plantations except in teak plantation. Similarly NPP was also greater in natural ecosystems compared with the plantations except teak plantations.

3531 Sundarapandian, S; Swamy, P.S; Box, J.E. 1998. **Variation in fine-root biomass and net primary productivity due to conversion of tropical forests into plantation crops and agroecosystems**. Root demographics and their efficiencies in sustainable agriculture, grasslands and forest ecosystems: Proceedings of the 5th Symposium of the International Society of Root Research, 14-18 July 1996, Clemson University, South Carolina: 369-382. Developments in Plant and Soil Sciences 82. Kluwer Academic Publishers, Dordrecht, Netherlands.

The changes in fine-root biomass and net primary productivity following conversion of tropical forests into forest plantations of *Tectona grandis* and other species and agro ecosystems were studied at Kodayar in Western Ghats. Root biomass and NPP were significantly altered in man-modified ecosystems. Very fine-root biomass and NPP were significantly greater in natural ecosystems when compared with monoculture plantations and agro ecosystems except in teak plantations.

3532 Suri, S.K. 1974. **Qualitative and quantitative analysis of teak saw logs of Bastar forests**. Indian Forester 100(8): 483-490.

An analysis of data from auctions at six major depots in the Bastar Circle showed that sawlogs of grades I, II and III constituted 16, 48 and 18 percent respectively of the total annual volume of teak sawlogs auctioned. Cumulative curves were constructed to show the volume distribution of girths and lengths of teak logs.

3533 Suri, S.K. 1975. **Correlation studies between bole diameter and crown projection area as an aid to thinning**. Indian Forester 101(9): 539-554.

Regression analysis of data of trees of *Cedrus deodara*, *Abies pindrow* and *Tectona grandis* in Kerala showed a positive correlation between stem diameter and crown projection area for each species. The curves of number of stems per acre over diameter as predicted by the regression equation and those taken from yield tables are compared for each species. The use of the relation between the two variables as a guide to thinning and initial spacing is described, and their value for aerial survey purposes is noted.

3534 Suri, S.K. 1984. **A suggested model for quantitative assessment of plantations with particular reference to Pakela teak plantations of South Bastar Division (M.P.)**. Indian Forester 110(3): 253-263.

From dendrometric data collected the plantations are assessed as All India Site Quality II. Growth Achievement Indices are arrived at by comparing actual diameter, height, stems, basal area and volume with the estimated yield table figures.

3535 Swe, M; Booth, T.H. 1996. **Site selection and growth prediction in Myanmar**. Matching trees and sites: Proceedings of an international workshop, Bangkok, Thailand, 27-30 March 1995: 71-76; ACIAR Proceedings 63. Australian Centre for International Agricultural Research, Canberra, Australia.

The Forest Department has an annual planting target of 80 000 acres in Myanmar. *Tectona grandis* and some other hardwood species are favoured on good sites. Computerized mensurational models have been built to predict growth in existing plantation and natural forests, but there is also a need for analytical method using climate and soil data to assist species and provenance selection.

3536 Tangtham, N. 1971. **Structure and growth of once exploited teak forest**. (Thai). Forest Research Bulletin 18: p81. Kasetsart University, Bangkok.

Study was carried out in teak forest exploited for 20-25 years. Size class structure of teak was analysed. Increment and growth studies were carried out on stems of teak.

3537 Tantangkul, Ch. 1968. **Teak stem analysis in Klangdong teak plantation**. (Thai). Student Thesis. Kasetsart University, Bangkok.

3538 Taschan, Ch. 1962. **Volume determination of teak branches**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Estimated the total volume of branch wood of the crown. A significant correlation was observed between crown wood volume and d.b.h. of the tree. The bark volume accounts for 16.26 percent of total tree volume.

3539 Tawee Kaewla iad; Chanchai Yarwudhi. 1975. **The estimation of the total amount of teak foliage**. (Thai). Faculty of Forestry, Kasetsart University, Thailand, Research Note 12: 11p.

The relations between number of leaves and total leaf surface area, total leaf weight, d.b.h. and total height were calculated for teak trees. Number of leaves was linearly correlated with each of the other characters; d.b.h. was better than total height for estimating the number of leaves.

3540 Tego Agbo Kangni, M. 1990. **Contribution to the elaboration of volume tables for teak in the coastal region and in the plateaux region (Togo)**. FAO F0 PNUD, FAO TOG 87 001, Lome, Togo: 18p.

3541 Tetuko, S.S.J; Tateishi, R; Wikantika, K. 2001. **A method to estimate tree trunk diameter and its application to discriminate Java-Indonesia tropical forests**. International Journal of Remote Sensing 22(1): 177-183.

A numerical method was used to analyse the interaction of L-band microwaves with the trunks of four species of Java-Indonesian trees including *Tectona grandis*. The horizontal polarization of the scattered wave was derived in order to calculate the relationship between tree trunk diameter and backscattering coefficient.

3542 Thaiutsa, B; Kaitpraneet, W. 1976. **The observation on ages, dbh and density of plantation teak at Huay Tak Teak plantation, Lampang**. (Thai). Faculty of Forestry, Kasetsart University, Thailand, Research Note 20: 12p.

On the basis of measurements in teak plantations of various ages, equations were developed to express the relations between d.b.h. and age, and between number of three per rai and d.b.h. or age. The equations were used as a guide for thinning.

3543 Thompson. 1927. **Growth of teak in Nigeria**. Forest Administration Report, Nigeria 1926-27: 16p.

3544 Thongma, Ch. 1965. **Effect of gamma radiation on the growth of teak**. (Thai). Student Thesis. Kasetsart, University, Bangkok.

After studying results with eight treatments, control and with radiation strengths of 1000 R, 1700 R, 3000 R, 4500 R, 6000 R, 8000 R and 10,000 R, the germination was found good for irradiation of below 6000 R strength and excess doses than this affected growth of stem and doses below 3000 R are not effective in accelerating growth rate.

3545 Tint, K; Schneider, T.W. 1980. **Dynamic growth and yield models for Burma teak**. Mitteilungen, Bundesforschungsanstalt fur Forst und Holzwirtschaft, Hamburg Reinbek 129: 93p.

A computer simulation model was developed for analysis of stand basal area and volume growth as functions of diameter class distribution and site class. Output consists of growth and yield tables of a natural teak selection forest in central Burma and for teak plantations giving stand statistics by 5-yr age intervals, including mensurational and yield data for main crop and thinnings, m.a.i. and c.a.i. Volume tables used in developing the model are given.

3546 Tireman, H. 1918. **Measurements of a teak tree**. Indian Forester 44(2): p86.

Records dimensions of a big teak tree in the forests of Southern Coorg. The girth of the tree at breast height was 25'2" and three logs of 562 cu. ft. were taken from the tree.

3547 Torres, F. 2000. **The potential teak in Brazil**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 145-150. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

Teak plantation programs in Brazil were initiated in 1971 with seeds from Trinidad provenance and Myanmar origin. Since then over 1,400 ha plantations have been established. An overview of the forests and the plantations of the country is provided.

3548 Unwin, R. 1937. **The yield in teak selection forests in Burma**. Indian Forester 63(6): 371-380.

Reports on yields and working of the system in Burma teak forests and suggestions are offered on fixation of yield specially in bamboo flowered areas.

3549 Vanclay, J.K; Skovsgaard, J.P; Hansen, C.P; Vanclay, J.K. 1995. **Assessing the quality of permanent sample plot databases for growth modeling in forest plantations**. Growth and yield estimation from successive forest inventories. IUFRO Conference, Copenhagen, 14-17 June 1993. Forest Ecology and Management 71(3): 177-186.

This paper illustrates graphical procedures to evaluate existing databases, to identify areas of weakness and to plan remedial sampling. Two graphs, one of site index versus age, another with stocking versus tree size provide a summary of the site and stand conditions represented in the database.

3550 Vasquez, C.W; Ugalde Arias, L.A. 1995. **Yield and site quality for *Gmelina arborea*, *Tectona grandis*, *Bombacopsis quinatum* and *Pinus caribaea* in Guanacaste, Costa Rica**. Serie Tecnica: Informe Tecnico Centro Agronomico Tropical de Investigacion y Ensenanza 256: 33p. Centro Agronomico Tropical de Investigacion y Ensenanza, Turrialba, Costa Rica.

The results are given of a study on site quality, variables influencing growth and yield, for the four species including teak, most used for reforestation in Costa Rica.

3551 Veillon, J.P; Silva, R. 1972. **Volume tables for standing trees and yield tables for forest plantations in Latin America**. (Spanish). 71p. Merida, Instituto Forestal Latinoamericano, Venezuela.

A compilation of 53 volume and yield tables giving data for several native species including teak arranged by regions.

3552 Vincent, A.J. 1964. **Plantation teak (*Tectona grandis* Linn.f.) sample plot Perlis No. 1 Mata Ayer forest reserve**. Malaysian Forester 27(2): 148-173.

Details are given of the stocking, growth, structural development and yield of a pure teak plantation. The relation between stem diameter, total height, mean crown diameter and crown freedom and their increments were examined. Crop was compared with yield table for teak plantations in India, Burma and Java.

3553 Vincent, L; Moret, A.Y; Jerez, M. 2000. **Comparative study of several stocking regimes in teak plantations at the Caparo Forest Experimental station, Barinas State, Venezuela**. (Spanish). Revista Forestal Venezolana 44(2): 87-95.

A comparative yield study from teak plantations with different stocking levels at the Caparo Forest Experimental Station, Venezuela is made. Plots with intensive thinning and wide spacing and moderate thinning with 4 x 4 m and thinning at age 13.8 years showed the greatest proportion of timber products.

3554 Wahyudi, I; Okuyama, T; Hadi, Y.S; Yamamoto, H; Watanabe, H; Yoshida, M. 2001. **Relationship between released strain and growth rate in 39 year-old *Tectona grandis* planted in Indonesia**. Holzforschung 55(1): 63-66.

3555 Waidarp, P. 1964. **The growth of teak heartwood**. (Thai). Student Thesis. Kasetsart University, Bangkok.

After analysing trees in different age classes in different quality sites, a correlation was worked out between d.b.h. and volume of heartwood present.

3556 Wangtara Buitan. 1967. **Testing the using of increment borer for finding the diameter teak growth**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The increment borer results compare favourably with direct measurement of diameter for calculation of mean annual increment.

3557 Warta, A.J. 1926. **Teak production in British India, Siam and the Netherlands East Indies**. (Dutch; English). Tectona 19: 493-508.

The difference in exploitation and marketing of products in British India and Dutch East Indies is compared and problems are discussed.

3558 Warta, A.J. 1926. **The abnormal ratio of the presence of different lengths in the teak timber of forest service**. (Dutch; English). Tectona 19: 843-847.

The abnormal ratio of the presence of different lengths in a given size of teak timber is described and a method is indicated to periodically control this defect.

3559 Weaver, P.L; Francis, J.K. 1990. **The performance of *Tectona grandis* in Puerto Rico**. Commonwealth Forestry Review 69(4): 313-323.

Twenty-seven plantations of teak were surveyed in Puerto Rico. Nearly half of the plantations surveyed appeared to be attaining at least 24 m height in 50 years. The best growth was at relatively low altitude sites with deep well-drained soils. Growth is compared with teak plantations in the Caribbean.

3560 Weeraratna, W.G. 1957. **Some growth data of teak in Ceylon**. Ceylon Forester 3(2): 167-170.

The progress of crop diameter growth is investigated in sample plots, representing five of the more important teak growing centres in Ceylon, namely, Pullumaliai, Vakaneri, Palugama, Madawachchiya and Mihintale.

3561 Weerawaradne, N.D.R. 2000. **Site, technology and productivity of teak plantations in Sri Lanka**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 69-82. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

Teak is one of the most demanding and valuable timber species grown in Sri Lanka. The Forest Department is mainly responsible for plantation establishment since the 1870s. Under a five year program state lands is leased to private individuals for a period of thirty years and technical support is provided for planting teak. Discussed the silvicultural management practices and the financial analysis of plantations in the country.

3562 Wehlburg, A.F. 1909. **More on young growth on so called contract cultivation**. Tectona 1: p562; 2: p22.

3563 Wilhemi, T. 1950. **The increment of teak according to Indian and Netherlands-Indian yield tables**. Mitt. Bundesanst. Forst u. Holzw. 20: 11p.

Data for the top quality classes in India and Java show only slight differences. Increment in volume and dry wood substance is compared, using Weck's absolute height quality with that of European species.

3564 Wimbush, A. 1920. **Big teak in Madras**. Indian Forester 46(5): 247-249.

Records a tree recently felled at Palacadavu in South Coimbatore which yielded 5 logs with an outturn of 1099 cu.ft., and also yield of 100 other big teak which yielded 210 logs of 28922 cu.ft. with an average volume of 138 cu.ft. per log.

3565 Win, S; Kumazaki, M. 1998. **Teak yield regulation in the natural forests of the Tharrawaddy Forest Division, Myanmar: 138 years of the girth limit selection system**. Journal of Forest Planning 4(2): 43-51.

Attempts to introduce scientific management techniques to forestry in Myanmar began in 1856 with the appointment of D. Brandis. Main management objective was to ensure a permanent and sustained yield of teak from the natural forests. To this end a girth limit selection system was adopted in the Tharrawaddy forests of Pegu, with the minimum exploitable girth limit set at 6 feet.

3566 Wiroatmodjo, R.S; Effendi, R.M. 1957. **The correlation between density of the canopy and density according to basal area in teak stands**. (Javanese). Rimba Indonesia 6(1/2): 35-51.

Measurements were made on sample plots in teak plantations of different site quality and age. Results indicate that in young and old stands where density of the canopy is low and in young stands where it is high.

3567 Wiroatmodjo, R.S; Effendi, R.M. 1958. **Increased felling yield and the estimation of volume in teak forests**. (Javanese). Rimba Indonesia 7(10/12): 462-475.

The increased demand for teak in Indonesia in recent years, and the consequent reduction in quality requirements, have led to the felling of a greater volume of timber. Crop volume of mature teak plantations has been calculated as timber volume but in present conditions it can best be calculated as stemwood volume, i.e. as containing some lower-quality material.

3568 Wolff von Wulfing, H.E. 1926. **Yield tables and estimates**. Tectona 19: 1017-1039.

Discusses the need for new yield tables and local yield tables for teak and suggests a method for preparation of stem volume table in estimating workable timber on the principle of largest possible output under the existing classification for sizes and quality.

3569 Wolff von Wulfing, H.E. 1929. **The appearance of longitudinal furrows in *Tectona grandis* Linn.f**. Tectona 22: 723-779.

3570 Wolff von Wulfing, H.E. 1929. **The occurrence of furrows and fluting at breast height in plantation-grown teak (*Tectona grandis* Linn.f.)**. Korte Meded-Lingeen Proefstation Boschbow, Buitenzorg 16: 57p.

3571 Wolff von Wulfing, H.E. 1931. **A comparison of the teak plantation with stands of European timbers**. Tectona 24: 825-865; p1091.

Various characteristics of stands including number of trees left and removed, volume production, basal area, heights, diameter etc. are compared. At these ages basal area and heights are maximum for teak.

3572 Wolff von Wulfing, H.E. 1932. **Yield tables for teak plantations (*Tectona grandis* Linn.f.)**. Tectona 25(11): 1425-1509; Indonesian Forest Research Institute Publication No. 30a.

This paper discusses the teak sample plot investigations in Java started in 1895. They were undertaken to obtain an idea of the annual increment of teak plantations under varying forms and intensities of thinning.

3573 Wolff von Wulfing, H.E. 1932. **The sample plot investigation of A.E.J. Bruinsamma yield tables for teak plantations (Tectona grandis Linn.f.)**. Tectona 25(11): 1425-1509; Korte Meded. Proefsta Boschbouw 30a: 85p.

Paper discusses Bruinsma's sample plot investigation of Java teak aiming at determining annual increment of teak plantations under varying forms and intensities of thinnings, regeneration experiments by coppice and seed shoots. It is considered uneconomical to resort to natural regeneration on good soils and artificial regeneration is cheaper and quicker. The method of preparation of yield tables is explained.

3574 Wolff von Wulfing, H.E. 1933. **General volume and stem table together with some auxiliary tables for plantation grown teak (*Tectona grandis* Linn.f.)**. Bijlage Meded. Boschbouw Proefsta 27: p329.

Method of preparation of general volume tables for teak was described and results are compared statistically and correlations and interpretations for form quotients and form factors adopted was also given.

3575 Wolff von Wulfing, H.E. 1934. **Volume tables for the stands of teak plantations**. Tectona 27; Indian Forest Bulletin 87.

3576 Wolff von Wulfing, H.E. 1938. **Yield tables for even-aged plantations of Java teak - *Tectona grandis***. (Dutch). Tectona 31(3): 562-579; Korte Meded. Boschbouw. Proefsta. 63.

Yield tables for 6 quality classes for years 5 to 110 for thinnings and main crop and total production are given.

3577 Wutisatrian, A. 1967. **Stem analysis of teak in Mae Huad teak plantation, Lampang**. (Thai). Student Thesis. Kasetsart University, Bangkok.

At the age of 3 years height 3.20 m/and basal area at b.h. is 8 cm2 with a volume of 0.003 m2. At the age of 24 years the basal area increase 204 cm2 and volume 0.1625 m3.

3578 Yadav, A.S; Khare, P.K; Mishra, G.P. 1986. **Growth analysis and dry matter production of seedlings of tropical dry deciduous forest tree species of central India. 1. Teak - *Tectona grandis* Linn.f.** Journal of Tropical Forestry 2(4): 228-234.

Relative growth rate, net assimilation rate and average leaf area to weight ratio were calculated.

3579 Yawuthi, Ch. 1968. **Correlation between the growth in diameter of teak (*Tectona grandis* Linn.f.) and the depth of A-horizon of Thachai teak plantation, 1954, Sukhothai Province**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Diameter growth is significantly correlated to A-horizon depth. Stump diameter is also similarly correlated.

3580 Zambrano, T; Jerez, M; Vincent, L. 1995. **Preliminary simulation model of basal area growth of teak (*Tectona grandis*) on the Venezuelan western plains**. (Spanish). Revista Forestal Venezolana 29(39/41): 40-48.

Dynamic growth information was obtained from plots established in teak plantations in the Caparo Forest Reserve which represented different planting densities. Graphs are presented which enabled the permitted teak development in Ticoporo to be compared with that of Caparo and the prediction of yields.

3581 Zambrano, T; Suarez, M; Jerez, M. 2001. **An evaluation of precision of some regression models for estimating height-diameter rela-**

tionship in Teak (*Tectona grandis* Linn.f.) from thinned permanent plots. (Spanish). Revista Forestal Venezolana 45(2): 163-173.

Eleven linear and nonlinear regression models were tested for estimating height-diameter relationships in teak plantations using data obtained from plots at the Caparo Forest Reserve Experimental Station in Barinas, Venezuela. Height-diameter relationships are used in growth and yield models to predict the mean height for a given diameter at breast height or diameter class.

3582 Zech, W; Drechsel, P. 1991. **Relationships between growth, mineral nutrition and site factors of teak (*Tectona grandis*) plantations in the rain forest zone of Liberia**. Forest Ecology and Management 41(3/4): 221-235.

In 5- to 11-year-old teak plantations at Glaro, Cavalla and Bomi Hills in Liberia, growth and vigour of trees showed considerable variations. Deficiency symptoms as well as soil and plant analyses indicated that differences in growth intensity were mainly related to topsoil acidity and foliar calcium status.

3583 Zondag, J.L.P. 1927. **The proportions in length of the output of teak timber**. Tectona 20: 214-222.

The method of regulating cutting of teak to produce longer lengths followed in North Randieblatoeng has been described and cost influences of wages of labour on length of timber discussed.

3584 Zwart, W. 1938. **Classification of output from fellings in teak forest in Tjepoe (Java)**. (Dutch). Tectona 31(8): 549-554.

Go top

Productivity

3585 **The teak forests of Java**. Indian Forester 7(3), 1882: 212-214.

Steps taken for the conservation of teak forests of Java are reported. It is concluded that with a strict conservancy and extensive planting operations, Java will again rise into importance as one of the main sources of supply of teak timber for the European markets. The paper also contains detailed accounts on the history of teak forests of Java their extent and management.

3586 **Statistics of teak cultivation in Java**. (Dutch). Tectona 4, 1911: 340-348.

3587 **Suggestions for a new system of royalty payment for teak forests in Burma worked by lessees under purchase contract**. Indian Forester 42(1), 1916: 1-4.

Commenting on the present system of leasing out teak forests, the author suggests a new system to avoid delays, increase yields, reducing wastage, and working more efficiently and economically, and suggests royalty to be fixed per girdled tree.

3588 **Burma teak**. Indian Forester 62(7), 1936: p440.

A review of an illustrated and fascinating brochure issued by five large teak firms of Burma having leases with Government.

3589 **Annual report on the forest administration of Nigeria for the year 1940**. Government Printer, Lagos, 1941: 14p.

Teak has been raised successfully from direct sowings.

3590 **Administration report on the Forest Department in the Central Provinces & Berar for the year ending the 31st March, 1940**. Government Printing, Nagpur, 1941: 38p.

Bamboo regrowth may be a serious obstacle to teak coppice in the moist type. This can be overcome by felling and burning the bamboo a year or so before main fellings, cutting the regrowth with the tree crop, burning the felling debris, and removing all bamboos interfering with teak coppice.

3591 **Forest management research. Humid tuffaceous loams**. Caribbean Forester 16(1/2), 1955: 3-4 [15th Report of United States Tropical Forest Research Centre 1954].

Reports on the development of plantations on this type of site. A 16-year-old teak plantation in the Luquillo Forest on the exposed slope has attained a basal area of more than 100 sq. ft./acre, but the form of the trees is not as good as on deeper soils.

3592 **Annual report for 1962. Institute of Tropical forestry**. Caribbean Forester 24, 1963: 1-17.

Variations in the growth rate and form of *Tectona grandis* have been observed and it appeared that some of these were herditary.

3593 **Economic analysis of investments in forest plantations in Ecuador**. (Spanish). Direccion Nacional Forestal, Ministerio de Agricultura, Quito, Ecuador, 1987.

Out of six papers the following paper was on teak. Productive teak plantations in the tropical region of Ecuador.

3594 **Management and development of forest plantations using multipurpose species: Proceedings of a IUFRO meeting, Guatemala, April 1989**: 675p. Centro Agronomico Tropical de Investigacion y Ensenanza, Turrialba, Costa Rica, 1990.

Thirteen papers are on silviculture of various species including *Tectona grandis*.

3595 **Forestry and people in South-East Asia**. Bos Nieuwsletter 14(3), 1995: 112p. Foundation BOS, Organization for International Forestry Cooperation, Wageningen, Netherlands.

Out of a total of 11 papers one paper is on teak planting by farmers in Lao PDR .

3596 **Myanmar: Ample headroom in wood processing**. Asian Timber 15(3), 1996: 16-18.

Myanmar has three quarters of the world's premium teak supply. This article discusses resources of *Tectona grandis* and secondary timbers, the industry and opportunities for investment.

3597 Ainslie, J.R. 1930. **Teak sample plots in Nigeria**. Forest Administration Annual Report, Nigeria 1930: 18p.

3598 Aitchson, P.E. 1957. **Working plan for the Mandgod-teak pole forest in Kanara Eastern Division**. Forest Department, Mysore.

3599 Alfaro Murillo M de los, A. 1990. **Case study on the profitability and optimum use of resources in the forest plantations of Costa Rica**. (Spanish). 162p. Centro Agronomico Tropical de Investigacion y Ensenanza, Turrialba, Costa Rica.

The land used was classified into 3 site classes of I-III for which preliminary yield tables were developed for each species. Data on the costs of establishing and maintaining each class and species of plantation, and incomes and yields for each were collected and analysed using a linear programming model to give present net worth, internal rate of return and soil expectation value . The highest IRR was with *T. grandis*.

3600 Anstruther, K. 1897. **The scarcity of teak**. Indian Forester 23(1): 54-55.

The measures taken by the Forestry Service in Government of Burma and Siam to conserve teak are outlined and discussed.

3601 Ashutosh, S; Chand Basha, S; Pant, N.C; Sharma, R. 1994. **Considerations of demand-pattern and economic return of forest management and rationalisation of pricing of timber (teak)**. Indian Forester 120(6): 483-487.

For optimal returns from forest plantations, it is necessary to follow a management plan which is developed after consideration of the implications of demand pattern, rate of tree growth, and economic return in terms of sustainable utilization. It is suggested to have a rational basis for pricing of the final product. In this paper, a theoretical analysis is undertaken of these concepts using cost data from a hypothetical teak plantation and data on market demand from Jabalpur, Madhya Pradesh.

3602 Atkinson, D.J. 1937. **A note on the finances of the Kyetpyugan teak plantations**. Indian Forester 63(12): 814-826.

3603 Aung, K.M. 1983. **Management planning for teak forests in Burma. Ph D Thesis**. Forestry Abstracts 44(10): p599.

Abstract is provided.

3604 Aung, N.N. 1998. **Changes in the price structure of teak from 1936 to 1998**. Myanmar Timber Enterprise Commemorative Issue: 278p.

3605 Balagopalan, M; Nandakumar, U.N; Indira, E.P; Jayaraman, K; Varma, R.V; Mammen, C. 2001. **Problems and prospects of management of teak plantations in Kerala**. Tropical Forestry Research: Challenges in the New Millennium. Proceedings of the International Symposium, Peechi, India, 2-4 August 2000. R.V. Varma; K.V. Bhat; E.M. Muralidharan; J.K. Sharma, Eds: 183-191. Kerala Forest Research Institute, Peechi.

Various issues related to silviculture, genetic improvement, soil requirements, pest problems, productivity and economics of cultivation of teak in the context of past research results and current practices are discussed. Studies on nursery techniques and production of quality stock, plantation establishment, maintenance and harvesting practices are reviewed. The need for protecting the ecotypes and other gene pools is emphasized. The problems and causes for low fruit productivity in teak seed orchards are examined and the present status discussed.

3606 Ball, J.B; Pandey, D; Hirai, S. 2000. **Global overview of teak plantations**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 11-34. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

This paper examines trends in the establishment of teak plantations worldwide and identifies some of the environmental and economic issues and challenges for investors. An historical review of teak plantations of India, Myanmar, Lao PDR Thailand, Sri Lanka, Nigeria, Ghana, Cote d'Ivoire, Tropical Africa, Tropical America, etc. is provided. Teak plantation areas and the planting rates of teak plantations are also reported. Productivity and volume estimates of teak plantations are also discussed. Contributions of plantation programmes towards teak timber supplies are also examined. The cost of plantation establishment and maintenance and the financial returns from these plantations are also discussed. Recent trends in the establishment of teak plantations are also discussed.

3607 Balooni, K. 2000. **Teak investment programmes: An Indian perspective**. Unasylva 51(201): 22-28.

This article examines the growing importance of investment in tree plantations in India, the involvement of forest based industries in raising plantations to meet their raw material requirements and the myths and realities surrounding teak investment programmes.

3608 Banijbhatana, D. 1956. **Teak forests of Thailand**. Proceedings of the 4th World Forestry Congress, Dehra Dun, 1954: 299-311.

Describes the principal forest types, stocking of teak, reservation, and working plans.

3609 Banijbhatana, D. 1957. **Teak forests in Thailand**. Tropical Silviculture 2. FAO Forest and Forest Product Studies 13: 193-205.

Describes distribution and extent of teak forests, factors governing the same-climate, topography, geology and soil. Gives teak forest types, growth statistics, reservation and working plans in Thailand. The rate of growth of teak varies with site quality.

3610 Banjibhatana, D. 1962. **The management of forests in Thailand**. Royal Forest Department, Bangkok 49: 1-12.

3611 Barbour, R; Gonzales, De M.M. 1958. **Forestry survey report to the Government of Eucador**. FAO/EPTA Report 748. FAO, Rome.

Report on forestry of Eucador gives details under forest types, forest improvement, transportation, forest industries, forest utilization, land use, reforestation, forestry nursery, forestry research, forest policy and appendices on tree species - teak plantation cost, forest products, export and import.

3612 Beck, H.J.L. 1932. **The definite organization for teak forestry**. (Indonesian; English). Tectona 25: 1410-1424.

3613 Beddome, R.H. 1878. **Report upon the Nilambur teak plantations**. Government of Madras.

3614 Beekman, H. 1914. **Working plan for research into the most efficient management and yield of teak stands**. (Indonesian; English). Tectona 7: 219-244.

3615 Beekman, H. 1918. **Working plan for the thinnings and output research and research into the flora of the teak forest**. (Indonesian; English). Korte Meded Proefsta Boschw: 1-35.

3616 Beekman, H. 1920. **Economic results that come from an analysis of a teak stands**. (Indonesian; English). Tectona 13: 166p.

3617 Beekman, H. 1920. **Teak in Java**. CFI, Oxford.

3618 Beekman, H. 1920. **The financial cycle of the full grown teak forests in clear felling operations with respect to IV. 'Groeiplaats-boniteit' (site quality class) in the forest district of Margasari, Java**. (Indonesian; English). Meded Proefsta Boschw 6: 166p.

Discusses the financial rotation for high-stemmed teak forest under clear fellings system on fourth site class in the forest district Margasari, Java.

3619 Begue, L. 1956. **The first session of the Teak sub-commission of FAO, Bangkok**. Bois et Forests des Tropiques 48: 7-19.

Gives some figures for production and a general description of teak in Thailand, as well as an account of the conference.

3620 Bekker, C; Rance, W; Monteuuis, O. 2004. **Teak in Tanzania: II. The Kilombero Valley Teak Company**. Bois et Forests des Tropiques 279: 11-21.

The Kilombero Valley Teak Company was set up in 1992 in Tanzania by the Commonwealth Development Company to supply the world market with Tanzanian plantation teak. This paper reports the main characteristics and accomplishments of the Kilombero Valley Teak Company project and orientations for the future.

3621 Bellouard, P. 1954. **Teak in French East Africa**. (French). Centre Technique Forestier Tropical, Nogent-sur-Marane (F.).

3622 Berkhout, A.H. 1899. **The future of teak forests in danger**. Indian Guide.

3623 Bertha, R.A; Vicente, S.M; Bello, A; Hector, C. 1996. **Initial growth and economical and ecological importance of 10 forest tropical species**. Proceedings of Scientific and Technological Meeting of Forestry, Agriculture and Husbandry, Mexico, 1996: 7p.

Including teak.

3624 Best, J.W. 1920. **Teak plantations in the Melghat Division of Berar**. Indian Forester 46(8): 411-415.

In the Sipna valley of Berar, earliest teak planting was taken up in 1868 and by 1879 a plantation of about 1000 acres were raised and commenting on their present condition and growth rates the author considers teak growing as a sound financial endeavour.

3625 Best, J.W. 1920. **Treatment of teak forest in the Central Provinces**. Indian Forester 46(4): 199-200.

3626 Beversluis, J.R. 1926. **Production costs of teak timber**. (Indonesian; English). Tectona 19: 1063-1069.

The paper is considered as an analysis of certain results of the working of teak forests in Java under definite working plans, but is not meant to calculate and lay down principles of remunerativeness of teak forests and give indications on the financial concepts and business like actions of the forestry service.

3627 Bhat, K.M. 1997. **Managing teak plantations for super quality timber**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 28-31. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

This paper examines the scope for production of super quality timber in future teak plantations. The available data indicate tremendous opportunities for wood technologists to exercise control over the wood properties not only to minimise timber defects of proportion of knots, juvenile wood, tension wood, etc. but also to improve the inherent qualities, when trees are to prepare an action plan and conduct research for evolving suitable management strategies to maximise the yield of superior-quality timber in future plantations.

3628 Block, F. 1922. **The teak forest district of Java during the last years**. (Indonesian; English). Tectona 15: 523-540.

Measures recommended include establishment of centralised accounting service, increasing the output proportionate with demand and allowable maximum and by better exploitation and felling methods, formation of timber stock, fixation of maximum price according to market conditions and production costs, lowering production costs by smaller wages, less personnal, avoiding capital investment, better forest production and simple working activities and change of timber sales policy after consulting the timber trade interests.

3629 Boer R.C de; Kuiper, L.C. 1996. **Teak, beautiful gold brown heart wood**. (Dutch). Bos en Hout Berichten, Stichting Bos en Hout 12: 4p. Stichting Bos en Hout, Wageningen.

Environment friendly investments in teak plantations in Netherlands are discussed. The origins of teak, growth assessments, timber quality, marketing are described.

3630 Bothmer K.H von. 1990. **The prospects for the teak economy in West Africa**. (German). Internationales Afrika Forum 26(2): 181-188.

An assessment is made of experience with teak in Togo and Benin. Details are given of the physical and socio-economic conditions in the region and the silviculture and performance of teak.

3631 Brandis, D. 1856. **Teak forests of Pegu**. Government Publication, Burma Forest Department.

3632 Brandis, D. 1861. **Attaran forests (Burma)**.

Government Publication, Burma Forest Department.

3633 Brandis, D. 1898. **Forest organization in teak plantations of Pegu, Burma**. Allg. Forest-u. Jagdztg 74: p45.

3634 Brascamp, E.H.B. 1915. **The civilisation of people in residency Rembang and management of teak forests**. Tectona 8: p72.

3635 Brascamp, E.H.B. 1921. **Report from teak forests from Sidajoe about 1706**. Tectona 14(8): 811-813.

3636 Brascamp, E.H.B. 1921. **The teak forests of Pemalang, Tegal and Brebes in the year 1803, in Kolonial Archief No. XXIX**. Tectona 14(2): 925-928.

3637 Brascamp, E.H.B. 1922. **New Guinea, teak forests and no Hindoos**. (Indonesian; English). Tectona 15: 251-262.

Madjapahit Javanese may not have planted teak in New Guinea. The author is of the opinion that teak was not brought there by Hindoos or Europeans.

3638 Brennan, P. 1993. **SEC accuses local teak firm**. The Tico Times 37(1215). San Jose, Costa Rica.

3639 Browne, R.S. 1929. **Report on a tour of inspection of some of the teak plantations in the State of Travancore**. Indian Forester 55(11): 627-638.

Discussed methods of regeneration employed, seed collection and nursery techniques, planting, tending of teak and field crops and weeding and harvesting of main teak and agricultural crops. A note on merits of taungya and regular plantations is given with a description of climate, soil and locality factors of plantation areas in various forest divisions. The problem of growing pure teak plantations and suitable mixtures is also discussed and compared with Nilambur.

3640 Bruinsma, A.E.J. 1894. **Forestry in the Dutch East Indies**. East Indies Guide.

3641 Buffe, J. 1961. **Teak plantations in Dahomey**. (French). Centre Technique Forestier Tropical, Nogent-sur-Marne: 18p.

Nursery practice, plantation methods, increment and yield and financial returns are described and the economic, social and political results of the plantations are discussed.

3642 Centeno, J.C. 1997. **Yield expectations of teak plantations. Trade in illusions**. (Dutch). Nederlands Bosbouwtijdschrift 69(1): 2-8.

The history and background of private investments by Dutch people in teak plantations in Costa Rica are discussed. Problems with conflicting data on increments are outlined.

3643 Cermac, F. 1954. **Report to the Government of Indonesia**. FAO/EPTA Report 309.

Describes the present timber production from teak forests and the need for a mechanization of logging. Notes are also given on the influence of mechanical extraction on natural regeneration of teak.

3644 Chalmers, W.S; Kenny, J.S; Bacon, P.R. 1981. **The natural resources of Trinidad and Tobago**. 223p. Edward Arnold (Publishers), London.

The physical, biological and human resources of Trinidad and Tobago are described. Included chapters on local sources of timber, utilization of forest products, plantation forestry including teak plantations, forest management and research, recreation, wildlife, national parks and indirect benefits of forestry.

3645 Champion, H.G. 1928. **Teak forests of Central and South India**. British Empire Forestry Conference Papers: 454p.

3646 Chatterjee, N. 1978. **Single factor analysis - a decision criterion for forestry operations**. Indian Forester 104(7): 506-516. 6.

This analysis can be used to decide what, if any, funds should be allotted for various forestry operations, by calculating their cost-effectiveness. The method is illustrated by applying it to a weeding and cleaning regime for a typical (hypothetical) teak plantation.

3647 Chatterji, A.L. 1882. **The korai teak forest**. Indian Forester 8: 266-268.

The Ghat forests of Satpura mountains largely teak type are described, its past management and results of fire protection are discussed. Experiments on coppicing of teak, yield and revenue from coppice fellings is given.

3648 Chaturvedi, A.N. 1995. **The viability of commercial teak plantation projects**. Indian Forester 121(6): 550-552.

Silvicultural aspects of the viability of commercial teak plantations in India are discussed.

3649 Chotipatana, P. 1966. **Teak forest management in Thailand**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The paper discusses the teak forest management in Thailand.

3650 Chowdhury, A.M. 1951. **Future of teak plantations**. Pakistan Journal of Forestry 1(4): 403-404.

3651 Contreras, G. 1992. **Economic assessment of forestry project impacts**. FAO Forestry Paper 17: 193p. FAO.

3652 Degbey, E.K. 1991. **Estimation of the valorisation costs of thinning products and thresholds of rentability of a forest project. The case of UGETAP project**. Ecole Superieure d' Agronomie, Togo: 183p.

3653 Doorn, A van. 1919. **About the teak forests of Damascsche in 1772 by E.H.B. Brascamp**. Tectona 12: 773-774.

3654 Doorn, Z van. 1926. **Costs of production in teak plantations**. (Indonesian; English). Tectona 19: 891-903.

Analyses cost of production in teak plantation.

3655 Doorn, Z van. 1927. **Is the organization of a Government teak business in the next business law etc. necessary or desirable?** Tectona 20: 612-619.

3656 Draaisma, C.L.M. 1928. **The development of the management of teak forests in Java**. Het Djati Bosch Bedrijf op Java: 127-172. Archiepel-Drukkeit, Buitenzorg.

3657 Draaisma, C.L.M. 1972. **The development of the management of the teak forests in Java**. Tectona 20: 153-198.

The different systems of teak forest management and their history since 1890 and forest regulations were traced and the author proposes reorganisation of staffing pattern of forest department to meet the present day needs and decentralization of work and executive powers.

3658 Duyfjes, J.J. 1923. **A bird's eye view of the management of the forests in Java in the years 1911-1920**. (Dutch; English). Tectona 16: 1-6.

An examination of the output of teak forests and the financial results of the system of forest management which clearly shows the stability of the policy under which these forests have been managed in the decade 1911-1920.

3659 Enters, T. 2000. **Site, technology and productivity of teak plantations in Southeast Asia**. Unasylva 51(201): 55-61.

Recommendations are given of the seminar organized by TEAKNET and FAO's Forestry Research Support Programme for Asia and the Pacific (FORSPA) in Thailand in 1999.

3660 Evers, J. 1905. **The Muthodi teak plantation of 1903-1904**. Indian Forester 31(12): 688-694.

The Muthodi state forest is described and teak planting since 1903 is discussed. Cost of silviculture management up to third year is also given.

3661 Fanani, Z; Kobashi, S; Miwa, K. 1990. **Development of the database for teak forest management in Java, Indonesia**. Bulletin of the Kyoto University Forests 62: 168-184.

The use of a computer database of forest inventory, soil type, land use, and topography to aid forest management is illustrated using as an example of the Mantingan Forest District, central Java.

3662 FAO. 1956. **National progress report on teak forestry: Burma**. FAO Teak Sub-Commission, Bangkok FAO/TSC-56/22: 13p.

3663 FAO. 1956. **National progress report on teak: India**. FAO Teak Sub-Commission, Bangkok FAO/TSC-56/27: 28p.

3664 FAO. 1956. **Report of the first session of teak sub-commission, Bangkok, Thailand, 9-18 February 1956**. FAO Teak Sub-Commission Bangkok FAO/TSC-56/30: 39p.

Includes recommendations of the first session, and national progress reports, presented to the first session of TSC at Bangkok, in Thailand, by Burma, France, India, Indonesia, Japan, Laos and Thailand.

3665 FAO. 1956. **Report on teak in Laos**. FAO Teak Sub-Commission, Bangkok FAO/TSC-56/9: 5p.

3666 FAO. 1957. **Report of the second session of the teak sub-commission at Bandung, Indonesia, 4-10 June 1957**. FAO, Rome FAO/TSC-57/31: 34p.

Report includes in addition lists of documents of the session and report, secretariat report and notes on the silviculture and management of teak, utilization, teak production, trade and prices, teak grading rules etc.

3667 FAO. 1960. **Progress report on teak forestry in Burma**. FAO Teak Sub-Commission, New Delhi FAO/TSC-60/2/3: 2p.

A brief report to the Teak Sub-Commission on teak forestry in Burma, on silviculture, management, utilization, production and grading rules.

3668 FAO. 1984. **Intensive multiple-use forest management in Kerala**. FAO Forestry Paper 53: 137p.

A case study reviewing existing management systems as applied to rain forests and teak plantations in the state. Forests cover about 25 percent of the land area and 16 percent of the forest area has plantations in Kerala. Plantation forestry dates back to the 1840s and systematic management of natural forest has been attempted in recent decades.

3669 FAO. 1995. **Forest resources assessment 1990: Tropical forest plantation resources**. FAO Forestry Paper 128. D. Pandey, Ed. FAO, Rome.

3670 Fock, W.H. 1910. **Position of Tectona (teak) forests in Soerakarta, Java**. (Dutch; English). Tectona 3: 237-262.

3671 Forest Department, Assam. 1939. **Notes from annual report on teak**. Annual Administration Report, Forest Department, Assam and Madras 1937/38.

Spacement and early stump planting trials in teak plantations are described. Irrigation is found to increase growth rate of teak. Methods of raising and mixtures suited for various soils are discussed.

3672 Forest Department, Madras. 1918. **Statistics of Nilambur teak plantations**.

3673 Forest Service, Bogor. 1957. **The teak forests of Tjepu (Java): History of management and its working plans**. Forest Service, Bogor: 40p.

This brochure is meant to give a picture of the historic development and the management activities of the teak forests in the forest district Tjepu - as a model for intensive forest management plan.

3674 Gallant, M.N. 1938. **A new basis for royalty assessment on teak in Burma**. Empire Forestry Journal 17: 80-83.

The new basis for royalty assessment on teak in Burma is related to market conditions.

3675 Galloway, G. 1994. **Management of forest plantations. Technical guide for forestry extension**. Serie Tecnica: Manual Tecnico Centro Agronomico Tropical de Investigacion y Ensenanza 7: 59p, Coleccion Materiales de Extension 1. Turrialba, Costa Rica.

The species discussed in this guide which include *Tectona grandis*.

3676 Ganglo, J.C; Lejoly, J. 1999. **Teak in Benin: Management and prospects**. (French). Bois et Forests des Tropiques 261: 17-27.

Teak has been planted in the country for more than 50 years and is of considerable socioeconomic importance because it offers employment opportunities and exports provide foreign currency. Priority research goals are discussed which include the identification of indicator plants and vegetation communities which identify good teak production sites.

3677 Gangopadhyay, P.B. 1997. **Report of the inter-departmental committee on the growth and economics of private plantations of teak**. Ministry of Environment and Forests. Government of India.

3678 Garland, E.A. 1934. **Methods of management in the mixed deciduous teak-bearing forests of Kanara, Bombay presidency**. Indian Forester 60(12): 819-837.

The history and methods of past management were described and suggestions are made for future management and silvicultural treatment of these forests, and the various operations to be carried out to improve the yield is discussed.

3679 George, M.P. 1961. **Teak plantations of Kerala**. Indian Forester 87(11): 646-655.

History, management, increment, injuries, and financial aspects are described, and a short account is given of current research projects.

3680 Gogate, M.G; Joshi, V.S. 1996. **An approach to resolve controversy on economy of teak plantation projected by private companies, Maharashtra - a case study**. Indian Forester 122(12): 1092-1108.

Discusses the economic basis for projecting physical and financial returns from teak plantations in India, including yield tables, local volume tables, stand density, site quality, yield variations, expected timber and smallwood, timber specifications and prices and changes in these over the years. Presents a case study from Maharashtra, which addresses the aspects covered and illustrated by data on yields and prices. Returns are assessed over various rotations of rainfed and high-input plantations.

3681 Goswami, K.V; Singh, S.B. 1976. **Cost benefit analysis of afforestation in deep ravines of Gujarat**. Indian Journal of Agricultural Economics 31(1): 48-55.

Evaluates investment in afforestation of deep ravines with species including teak as additional sources of income for farmers.

3682 Gupta, H.S. 1996. **Tree plantation schemes: Whether feasible?** Van Vigyan 34(4): 176-181.

A detailed evaluation is made of commercial plantation scheme guaranteeing high quality and returns from teak plantations after 20 yr. Despite the uncertainties expressed over such schemes and the need for some form of governmental control of them is stressed.

3683 Haidery, A; Sinha, J.N. 1954. **Teak plantation in Saranda Division, Bihar**. Indian Forester 80(2): p118.

Gives an account of teak plantation in the damp valleys which originally contained quality I/II sal forest. The yield from thinnings and revenue obtained is given.

3684 Hambananda, P. 1956. **Teak plantations in Thailand. FAO country reports on teak**. Udom Press, Bangkok.

About 1000 hectares could be planted with teak annually. An agri silvicultural method of establishing plantations is adopted in order to reduce the cost of production.

3685 Hamzah, Z. 1978. **Survey report on teak plantations in Lampung and S. Sumatra Provinces (Indonesian)**. (Indonesian). Laporan, Lembaga Penelitian Hasil Hutan, Indonesia 276: 36p.

3686 Haque, M.S. 2003. **Current status, future prospects, economics and policy issues for teak (*Tectona grandis*) investments by NABARD**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

National Bank for Agriculture and Rural Development (NABARD) is a developmental bank provides credit for promotion of sustainable agriculture including forestry for integrated rural development. Teak has great promise in rehabilitation of India's degraded forests and for raising farm forestry on wastelands on sustainable basis. Many state owned forest development corporations (FDCs) have already raised excellent plantations after availing credit from NABARD/Banks on long term basis. Now FDCs are proposing short rotation, intensive, irrigated teak plantations. During the last decade many private entrepreneurs floated companies asking investments in teak equity with promise of high returns. Suggested that teak is really a good tree for investment and strongly recommend for raising commercial plantations by the farmers and the FDCs on wastelands.

3687 Hardcastle, P. 1999. **Plantations: Potential and limitations**. World Bank Forest Policy Implementation Review and Strategy Development. Stakeholder Draft Document.

3688 Hardjosoediro, S. 1977. **The basic principles of planting and evaluation of teak forest management**. Gadjah Mada University, Yogyakarta, Indonesia.

3689 Harlow, C.M. 1919. **Treatment of teak forests in Central Provinces**. Indian Forester 45(10): 525-530.

The history of reservation and management of teak forests of Central Provinces is described. The note recommends a high forest system, instead of a coppice with standards or improvement felling system after discussing the present condition of crop and silvicultural prescriptions followed.

3690 Harnsongkhram, A. 1968. **Obstacle and opinion about teak plantations in N.E. Thailand**. (Thai). Proceedings of the first Silvicultural Seminar, Royal Forest Department, Ministry of Agriculture R 118: 228-234.

The main obstacle is costs, labour and machinery. The planting stock has to be raised in advance to plant more areas and the planting procedures and time of planting has to be improved. For timely planting to utilise maximum growing season, the authorities should cooperate with local people.

3691 Hashim, M.N; Mohd Noor Mahat; Krishnapillay, B. 2002. ***Tectona grandis***. A manual for forest plantation establishment in Malaysia: 245-258. Forest Research Institute Malaysia, Kuala Lumpur, Malaysia.

3692 Hill, H.C. 1890. **Suggestions for administration, Coorg. History of teak plantations**. Government Publication, Central Provinces: 39p.

3693 Hissink, L.A.G. 1909. **Annual reports of the forestry service in the Netherlands East Indies teak forests in Java and their management**. Forest Department, East Indies.

3694 Hissink, L.A.G. 1909. **Teak forests of Java and their management**. Tectona 2: 628-633.

3695 Hodgson, C.M. 1898. **Teak plantations**. Indian Forester 24(4): 123-125.

The teak plantations in the Ataran valley in Tenassarium, Burma, are reported, the method of raising and problems of locality factors are discussed.

3696 Hodgson, C.M. 1904. **On certain important forest questions**. Indian Forester 30(10): 467-470; 31: p82.

Examines the factors contributing to reproduction of teak: Exposure of seed to heat, presence of suitable mineral matter in soil and overhead light. The main problems of germination of teak seed in natural forest are examined.

3697 Hopwood, S.F. 1916. **Teak wood**. Indian Forester 42(1): 18-22.

Commented on the increased and extensive use of teak wood, discusses the working plan prescriptions and yields of present working and measures to meet the increased demand.

3698 Ibbotson, B.R. 1966. **The cost of establishment of teak in Gambari forest reserve**. Bulletin of Nigerian Forest Department 26: 19-27.

3699 Indira Devi, P; Saju Varghese; Manoj Kumar; Pratheesh, V.S. 2003. **Economics of teak plantations in Kerala**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

The study on economics of teak plantations in Kerala was undertaken to evaluate the present business economics of teak plantations in Kerala under government ownership. The total cost of a hectare of plantation spread over the rotation period was estimated to Rs.159,385 of which 3.83 per cent was invested during the establishment period. The study revealed that the returns from the first thinnings was enough to realize the cost incurred till then. When taungya system was practiced in the state, the revenue exceeded the cost in the first year itself. It is suggested that the concentration should be on timely scientific management to ensure maximum yield as the average yields in many plantations are below the site potential.

3700 Jacob, M.P. 1933. **Report and working schemes for the Travancore teak plantations**. Forest Department, Madras. Government Printing & Stationary, Madras.

3701 Janssen, H.W. 1997. **Collaboration between forestry, nature, environment and trade is not necessarily an illusion. Teak wood and Julio Cesar Centeno. A reaction to Julio Centeno**. (Dutch). Nederlands Bosbouwtijdschrift 69(1): 9-15.

It outlines OHRA's view to the discussion on private investments in teak plantations in Costa Rica.

3702 Jawtha. 1934. **Collection of royalty on teak timber in Burma**. Indian Forester 60(5): 330-334.

The method of collection of royalty in Burma is explained and the problems of assessment and measurement of timber and the quality are critically examined and discussed in detail.

3703 Jayadev, T. 1947. **Nilambur teak plantations 1846-1946**. Indian Forester 73: 498-500.

In memorandum of the century old Nilambur teak plantations, traces out their history and describes the pioneering efforts

of Mr. Conolly and Mr. Chattu Menon. The total area under teak is 7700 acres and the target of planting is 60-70 acres for replanting of pure teak and 150 acres in mixed forests after clearfelling.

3704 Jayaraman, K; Sreekumar, V; Sunanda, C. 1994. **A glimpse at the status of teak plantations in Kerala**. Evergreen 32/33: 2-4.

An examination of the overall status of teak plantations in Kerala is made. Information of age structure, stocking and productivity levels of teak plantations in Kerala is given.

3705 Jayaraman, K; Zeide, B. 2003. **Optimal management of teak plantations**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

An efficient way to increase productivity of teak plantations is to optimize their density and rotation age. It is found that bringing up the density of understocked stands and reducing the index of overstocked stands will increase productivity by 42 percent. Bringing down the rotation age from the current 60 to 50 years will increase the returns by 2.6 percent.

3706 Jenstch. 1908. **Notes on teak in Java, Siam and East Africa**. Zeitschrift fur Forst. U-Jagdwesen 40: p807.

3707 Jha, M. 1999. **A preliminary study on comparative growth and economic returns from rainfed and irrigated teak plantations**. Indian Forester 125(12): 1198-1203.

A comparative study was made of the performance of a conventional rainfed teak plantation of the Maharashtra Forest Department and an irrigated private teak plantation on an adjacent site. Data collected on girth and height growth showed that irrigation in the early phase had positive effects on growth. The net profit in the irrigated plantation was 2.28 times more than that in the non-irrigated plantation. It is suggested that teak can be used profitably as a farm forestry species.

3708 Jnnes, C.A. 1908. **Madras District Gazattiers: Malabar Vol. 1**. Government Press, Madras: 71p. P.B. Evans, Ed.

3709 Joo, R.W; Lee, S.Y. 1996. **Investment environment for overseas tropical hardwood plantation forestry**. FRI Journal of Forest Science Seoul 53: 65-77.

From the perspective of securing hardwood log supplies from overseas for the Korea Republic, the suitability of several countries - Malaysia, Papua New Guinea and the Solomon Islands - for tropical hardwood plantation projects was examined. Information was collected and analysed on foreign investment opportunities for plantation forestry. The analysis showed that investment in fast-growing plantation projects is highly profitable for pulpwood production.

3710 Joshi, N.J. 1975. **Use of computer for calculating the internal rate of return of teak plantations in Thana forests of Maharashtra State**. Indian Forester 101(3): 165-169.

Briefly discusses the advantages of calculating the internal rate of return by computer and explains, with an abbreviated flow diagram, the use of an internal halving programme for the calculation. The internal rates of return for teak plantations in Thana calculated by computer are compared with the interest rates as calculated in the working plan for the reserved forests of Thana.

3711 Kartasubrata, J. 1993. **Sustainable forest management in Indonesia, case study: Teak forest in Java**. Duta Rimba 19(159/160): 33-47.

Topics covered include teak forest management during the Dutch East Indies Company (VOC) and post-VOC periods, personnel involved, organization, planning, reforestation, regulation of harvesting and socioeconomic aspects, needs from the forests, use of the taungya system, and the social forestry programme initiated in 1984.

3712 Keogh, R.M. 1979. **Does teak have a future in tropical America? A survey of *Tectona grandis* in the Caribbean, Central America, Venezuela and Colombia**. Unasylva 31(126): 13-19.

Data are presented on areas of plantations, provenances, increment and yield, volume production and thinning practices in the region. A provisional site classification chart is presented.

3713 Keogh, R.M. 1987. **The care and management of teak (*Tectona grandis* Linn.f.) plantations**. 48p. Universidad Nacional, Heredia, Costa Rica.

A practical field guide for use in the Caribbean, Central America, Venezuela and Colombia. Management of teak in pure plantations and in taungya and in mixed with various crops is described. A teak bibliography is included with a keyword index.

3714 Keogh, R.M. 2000. **New horizons for teak plantations**. Proceedings of the 3rd Regional Workshop on Teak, Indonesia.

3715 Kerala Forest Department. 1977. **Teak in Kerala**. Kerala Forest Department, Trivandrum.

3716 Khaziah, A.K. 1992. **Investment incentives for forest plantation**. Proceedings of the National Seminar on Economics of Forest Plantation, Malaysia, 24-26 February 1992: 99-108.

3717 Kinhal, G.A. 1995. **Technical and financial evaluation of green equities**. Indian Forester 121(6): 566-572.

This paper concentrates on the upcoming corporate sector in plantation forestry by way of either company investment or investment from the public, looking in particular at plantations on owned land using funds raised from the market by way of shares/equities/debentures. An analysis of proposals presently being floated by various companies is done in terms of technical feasibility and financial viability, using data from the Kerala Forest Department on raising teak plantations.

3718 Kondas, S. 1995. **Teak - A paragon of excellence**. Malaysian Forester 38(4): 111-125.

3719 Kondas, S. 1998. **Teak farming in private sector: Information needs**. ITTO sponsored training Workshop on Tropical Forestry and Timber Trade Statistics. M.S. Swaminathan Research Foundation, Chennai.

3720 Kotwal, E.K. 1953. **Financial aspects of artificial teak plantations in the Kanara district of the Bombay State**. Indian Forester 79(11): 626-627.

Analyses costs of establishment and revenue from thinnings for two plantations.

3721 Krishna Murthy, A.V.R.G. 1997. **An investment of Rs. 1000 in teak grows to Rs. 50000 in twenty years! Is it a myth or reality?** Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 232-235. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

An advertisement in leading dailies under the title 'Rs.1000 grows to Rs.50,000 in 20 years on a single teak tree' has stirred the investors as well as foresters. Author suggests that the projected return of Rs.50,000 per tree is impossible in 20 years and thus the claim is a myth.

3722 Krishnabumrung, V. 1959. **On the out turn percentage in the conversion of teak logs**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Depending on sawmill conversion figures the out-turn percentage of teak is given. The use of various equipment is also discussed.

3723 Krishnapillay, B; Noor Mahat, M; Norini, H; Zuhaidi, A.Y; Ghani, A.R.A; Mahmud, A.W. 1998. **Viability of planting teak and sentang in Malaysia**. Planter 74(862): 19-34.

The potential of planting teak and *Azadirachta excelsa* in Malaysia on a plantation basis for commercial timber production is discussed. Properties of these species, their suitability for growth in Malaysia and the financial return on investment are considered.

3724 Kuchli, C. 1990. **Teak, tapioca and the forest villages in Thailand**. (German). Schweizerische Zeitschrift fur Forstwesen 141(6): 463-477.

An historical review, covering the teak policy in Thailand, the decline of the teak industry since the 1960s, and the change from a subsistence to a market economy, with increased cultivation of cassava for tapioca production, teak concessions and illegal fellings; afforestation and reforestation efforts in the teak areas and the establishment of the first forest village, the achievements of the forest village programme and the future prospects.

3725 Kumar, P.J.D. 1989. **The economics of teak plantation - 1. The economic viewpoint**. Myforest 25(4): 397-408.

An examination of the economics of the principle of sustained yield forestry management, which gives priority to raising successor crops, rather than to exploitation of existing resources.

3726 Kumar, P.J.D. 1990. **The economics of teak plantation - II: The financial analysis**. Myforest 26(1): 73-93.

A financial analysis of teak plantations in North Kanara district, Karnataka, is undertaken. The studies covers silvicultural requirements, growth and yield, yield tables and standing crop, costs, net benefit flows, the role of market prices, the economics of teak plantation, optimal rotations under sustained yield, optimal rotations.

3727 Kumar, P.J.D. 1990. **The economics of teak plantation - III: Rotation, conversion, and the financial criterion**. Myforest 26(2): 105-117.

The papers examine the economics of teak plantings as part of the regeneration programme of the Karnataka Forest Department. Aspects discussed include the planting decision and the supply function, sustained yield and the cost of postponing planting, sustained yield and the cost of delayed conversion, the impact of the economic criterion, sustained yield and the interests of stability and sustained yield, stability and the interests of the poor.

3728 Kyi, Maung. 1959. **A critical study of the modern methods of forest management and yield regulation, with special reference to their application to the teak forests of Burma**. Thesis, Imperial Forestry Institute, University of Oxford: 197p.

The successive stages in the development of European forestry are traced from 14th century leading to the present day concept of sustained yield management aiming at coordination of silviculture and economics. The silvicultural and socio-economic conditions that affect this principle are discussed. The role of management of forests to achieve the desired silviculture and economic results is stressed. The history of forest management in Burma is stressed with special reference to Burma selection system.

3729 Kyi, Maung. 1962. **Basic experience paper on teak in Burma**. UNCSAT Conference United Nations, Geneva E/CONF.39/C/25, 51, 6991, 505, 506, 243: 7.

Includes paper contributed under this item on experience of Burma.

3730 Lal, J.B. 1973. **Economics of teak plantations - Ignored factors**. Forestry Conference (Silvicultural Conference) 6-10 December 1973, 97. Forest Research Institute, Dehra Dun.

The economic return from natural mixed miscellaneous forests are compared with the returns from teak plantations. It has been shown that such factors as the returns from other forest products like Tendu leaves, myrobalams, etc. in natural forests, the loss in fertility on conversion to plantation, ecological benefits of natural forests and the likely changes in demand of teak wood, the conversion to plantations has no improvement on the natural miscellaneous forests.

3731 Lamb, A.F.A. 1955. **Trinidad's teak forests**. Journal of Agricultural Society, Trinidad and Tobago 55(E).

3732 Lamb, A.F.A. 1957. **Teak in Trinidad**. Tropical Silviculture Vol. 2: 179-186, Forestry and Forest Products Studies 13. FAO, Rome.

Silviculture of gregarious forest types especially teak in Trinidad and Tobago dealt with its geographic distribution, ecological factor, planting, forest injury, forest protection, volume and yield.

3733 Lamb, A.F.A. 1967. **Impressions of Nigerian forestry after an absence of 23 years**. Commonwealth Forestry Institute, Oxford.

3734 Letourneux, C. 1956. **Costing forestry operations**. 12th Congress of International Union of Forest Research Organizations, Oxford, 1956 IUFRO 56/31/5: 4p.

Analyses costs for different types of plantation like teak by the taungya system in Indochina, Ceylon and Siam.

3735 Levingston, R. 1969. **Report of tour of teak forests of Togo**. FAO Tour Report 24.6.69 to 5.7.69, Appendix 2, Report 1: 6.

Summarises information on teak stands visited by experts giving in tables the basal area, dominant height, number of trees/ha., mean annual increment and observations are made on nursery and plantations establishment practices.

3736 Loetsch, F. 1960. **Report to the Government of Indonesia on the application of mean tree tariffs for the further development of forest management of the plantation forests**. FAO Report 1281, 1960: 114p. Expanded Technical Assistance Program, FAO, Rome.

Emphasizes the suitability of the volume table in the forest inventory of even-aged plantation forests, especially for tropical fast-growing species. Its advantages are simplicity and a sound statistical basis. A tariff was constructed for teak plantations.

3737 Lowe, R.G. 1973. **Plots in managed plantation crops in the high forest zone of Nigeria**. Federal Department of Forest Research, Nigeria, Research Paper Forest Series 17: 20p.

Gives preliminary increment data from managed and untreated plots of species including *Tectona grandis*.

3738 Lowrie, A.E. 1897. **Kumri teak plantations**. Indian Forester 23(10): 370-374.

The method of raising Kumri teak plantations in Kuramba forest village, Coorg are described including raising nurseries.

3739 Lugt, C.S. 1926. **The costs in teak forests of Java**. Tectona 19: 602-613.

3740 Mahalaha, S.H; Tewari, D.N. 1975. **Intensive forest management planning in Bastar**. Indian Forester 101(6): 307-313.

Discusses the need to increase the utilization of forests in the region, mainly by improved management. It is intended to replace existing stands with a maximum stocking of species selected as being economically desirable and amenable to the intensive management. Among these, prime consideration is given to species which include *Tectona grandis* and a comparison is made of benefit/cost ratios, net present value, and internal rate of return on various rotations.

3741 Maheut, J; Dommergues, Y. 1961. **The teak plantations of Casamance**. Centre Technique Forestier Tropical, Nogent-sur-Marne: 14p.

Discussed plantation technique, yields, financial returns and usefulness to the local population.

3742 Maitland, V.K. 1925. **Volume tables for *Tectona grandis* (teak) and *Shorea robusta* (sal), for the Central provinces**. Indian Forest Records 2(7), Silviculture Series: 215-222.

3743 Maldonado, G; Louppe, D. 2000. **Challenges of teak in Cote d'Ivoire**. Unasylva 51(201): 36-44.

An analysis of the choices made in the Cote d'Ivoire with regard to the development of teak production, national forest policy, teak trade and marketing in a changing national and international context.

3744 Mammen, C. 1986. **Pattern of investments in forestry and its implications on sustained yield management in Kerala**. M.Phil Dissertation. Centre for Development Studies, Thiruvananthapuram.

3745 Mammen, C. 2000. **Teak plantations in Kerala: An economic review**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 239-261. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

In Kerala, teak occupies the largest area among the plantations raised by the Forest Department. Several private companies have come forward with attractive return for investments in teak plantations during early 1990's. Analyzed the productivity and profitability of teak plantations in government forests in Kerala in order to assess the assertions made by the private sector.

3746 Mathauda, G.S. 1956. **Multiple yield table for teak**. Indian Forest Records (n.s.) Silvicultural Series. Forest Research Institute, Dehra Dun.

3747 McGregor, A. 1877. **Memorandum on the Conolly teak plantations at Pelambur, Malabar district**. Indian Forester 3(2): 101-111.

3748 McIntosh, R. 1905. **The Nilambur teak plantations**. Indian Forester 31(3): 127-132.

The history of raising teak plantations in Malabar since 1840 due to pioneering efforts of Mr. Conolly and Mr. Chattu Menon, specially the problems encountered in teak seed germination and transplanting are discussed. The systems of management and tending of these plantations under different schemes is traced and forecast of yield and stocking given.

3749 McKerlie, J.E. 1958. **The prospects of teak in Tanganyika**. Imperial Forestry Institute, Oxford: 29p.

Analyses the environmental factors in teak growing countries, compared them with those of Tanganyika. Also reviews and analyses the requirements of teak against background conditions prevailing in Tanganyika.

3750 Mehendale, V.D. 1959. **Teak in Northern and Central Bombay**. Proceedings of All-India Teak Study Tour and Symposium December 1957-January 1958, Dehra Dun: 148-153.

Gives notes of occurrence, forest types, outlines of present methods of treatment under selection-cum-improvement cum clear-felling, coppice system, improvement fellings, natural regeneration in dry deciduous and moist deciduous forests, artificial regeneration, tending and production.

3751 Mehta, U.V. 1995. **Technical and financial viability of commercial plantation: A study of teak plantation schemes in Gujarat and Tamil Nadu**. M.Phil Thesis. Indian Institute of Forest Management, Bhopal, India.

3752 Meka, E.Z; Adetchessi, L. 2002. **Forestry in development**. ITTO Tropical Forest Update 12(2): 3-5.

This paper describes an International Tropical Timber Organization project for a 2500-ha timber production plantation in the reserved forest of Haho-Baloe in Togo, for which financing agreement was signed in 1998. The project includes various forestry activities, such as logging and re-establishment of the teak plantations, the production of seedlings, the establishment of new plantations, and the protection, restoration and management of residual natural forests.

3753 Ministry of Trade and Industry, Malaysia. 1986. **Investment in the manufacturing sector - policies, incentives and procedures**. Ministry of Trade and Industry, Malaysia.

3754 Misra, D.N; Sathe, P.G; Mathur, R.S. 1975. **Return from standing timber in project-evaluation. Analysis of Maharashtra project**. Indian Forester 101(12): 723-729.

Criticizes some assumptions made in the assessment of the profitability of this project.

3755 Mitra, T.K. 1959. **The problem of teak plantation in the Kurseong Forest Division**. Proceedings of All-India Study Tour and Symposium for Teak December 1957-January 1958, Dehra Dun: 179-184.

History, distribution of areas for teak regeneration and management, locality factors, character of original vegetation, regeneration techniques, problems and remedial measures are discussed.

3756 Mizra, N.M; Mahendra, A.K; Ansari, M.Y. 1987. **Price trends of teak (round logs) in Orissa**. Indian Forester 113(5): 345-351.

Price data from the Forest Research Institute Timber Price Bulletins were analysed for 1968-81. The average annual growth rate of prices was highest for the larger girth classes. A comparison of trends in teak and general price indices showed that they were similar up to 1973 but that teak indices rose faster after 1974. A comparison of the average annual growth rate of teak and general price indices showed that they were similar.

3757 Moonrasarn, S. 1992. **Profit planning for teak plantation case: FIO's industrial plantation**. Proceedings of the Seminar on 50 Anniversary of Hyay-Tak Teak plantation, Bangkok, 5-8 August 1992.

The FIO had executed reforestation since 1989. The first priority is teak in Northern part of Thailand. The execution of industrial teak reforestation will be operated by 12 percent low interest loan. Clear cut and replantation system is considered to be done with rotation of 30 year. Mean Annual Increment will be at 0.5 cubic m/year/rai.

3758 Nair, P.N. 1967. **Economics of forest plantation in Kerala state**. Proceedings of the 11th Silvicultural Conference, Dehra Dun, 1967. Forest Research Institute, Dehra Dun.

The relative profitability of growing teak, eucalyptus and rubber plantations in Kerala state, India is discussed. Teak is almost as profitable as eucalyptus and more profitable than rubber. The economics of various plantations at the end of the specific rotation period are compared and discussed.

3759 Niskanen, A. 1998. **Financial and economic profitability of reforestation in Thailand**. Forest Ecology and Management 104(1/3): 57-68.

The financial and economic profitability of industrial, community and agroforestry based reforestation were assessed in North East Thailand. The profitability was evaluated for plantations using *Eucalyptus camaldulensis* and *Tectona grandis* and agroforestry based reforestation where cassava was intercropped with the tree species.

3760 Ouseph, K.P. 2003. **Should we evict forest encroachers? - a new way of looking at sustainable production of teak timber in Kerala**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Arguing the fallacies of the existing policy on the forestry, forest management and sustainable forest management. It argues for the need of a new perspective on the age-old problem of forest encroachments in

Kerala. Growing teak in forests alone will not be sufficient to meet the growing demands of the state. Attempted to estimate the demand for wood by various sectors and supplies from different sources in Kerala. Highlight the possibility of increasing supply of good quality, teak timber through new policy options, which will also ensure a solution for the problem of eviction of forest encroachments wherever it is impossible.

3761 Parameswarappa, S. 1993. **Teak - how fast can it grow? And how much can it pay?** Myforest 29(4): 231-232.

Tectona grandis in India.

3762 Parameswarappa, S. 1995. **Teak - how fast can it grow and how much can it pay?** Indian Forester 121(6): 563-565.

A brief discussion of teak growth and plantation economics in India.

3763 Pradhan, I.P; Dayal, R; Vasava, S.S. 1976. **Teak plantations in Mahi ravines and their economic evaluation**. Soil Conservation Digest 4(1): 10-16.

Establishment, survival, growth, management and economics of teak plantations in deep ravines are reported.

3764 Pringle, A.M. 1950. **The Enugu Pitwood plantations: Nigeria**. Empire Forest Review 29(3): 238-243.

Of many species tried teak and *Gmelina arborea* have been found useful for mining props and both are grown on a coppice and clearfelling system on 15 year rotation to produce 12 ft. prop.

3765 Rahman, A. 1977. **Profitability of teak plantations under the existing system of management in Bangladesh**. Bano Biggyan Patrika 6(1): 36-50.

The assessment was based on a 60-year rotation of *Tectona grandis* plantations and prices for 1975-76. It is suggested that in order to improve their profitability it will be necessary to improve their management.

3766 Ramnarine, S. 2001. **Proposed royalty rates for teak and pine in Trinidad**. Forestry Division Report, Mimeo: 22p.

3767 Rao, A.L. 1968. **Dry deciduous forests of Andhra Pradesh and their management-past and present**. 9th Commonwealth Forestry Conference, New Delhi, 1968.

The forests are of three types dry teak forests, *Pterocarpus santalinus* forests and dry mixed deciduous forests.

3768 Rao, D.S; Mehar Singh; Shivaraju, B. 1997. **Teak management in Kerala**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 32-37. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

The extraction not conservation was the sole object of teak management, which was continued till 1840s. Prescriptions of Indian Selection System by Sir. Brandis was a milestone in the teak forest management which was developed and practised in the second half of the 19th century with considerable success. Conversion of teak bearing forests into plantations was continued till the discontinuation of clearfelling and selection felling in late 1980s. The first successful teak plantation raised by Sri. Chathu Menon, in Nilambur Valley in 1844, paved the way for establishing large scale plantations.

3769 Rao, Y.S. 1968. **View it as investment**. Indian Forester 94(5): 383-388.

Discusses the requirement of raw material for industry and analyses the economics of growing bamboo, eucalypt and teak. The need for forestry planning based on a proper understanding of economics is emphasized.

3770 Rawat, J.K; Negi, M.S. 1998. **Economic viability of teak plantations in India**. Proceedings of the National Conference on Teak, Jabalpur, India, 25-26 May 1998.

3771 Ribbontrop, B. 1898. **Note on the working plan for the Nilambur valley teak plantations**. Indian Forester 24(5): 163-169.

Remarks on Mr. Lushington's working plan of Nilambur teak plantations are presented.

3772 Ritz, A. 1934. **Comparison of the economic results of the Government teak plantations in the Netherlands, India**. (Dutch; English). Tectona 27: 83-100.

3773 Rodger, A. 1915. **The Myodwin teak plantations, Zigon Division, Lower Burma**. Indian Forester 41(10): 372-377.

The oldest teak plantations of 1862 and 1863 at Myedwin raised by sowings and nursery transplants respectively were described with cost after clearance and burning of existing low jungle. Thinnings carried out and the growing stock of the plantations are dealt with.

3774 Rodger, A. 1929. **Teak plantations in Coorg**. Inspection Tour Note, Madras Forest Department: 14p.

3775 Romeijn, P. 1999. **Green gold: On variations of truth in plantation forestry**. Thesis. Wageningen Agricultural University, Wageningen, Netherlands: 221p. Treemail Publishers, Netherlands.

Green Gold is a study using the Internet as the principal means of the Netherlands Teakwood Investment Program, which offered the Dutch public the opportunity to invest directly in a teak plantation project in Costa Rica. The study discusses how the management of the teak plantations was subsequently certified under the auspices of the Forest Stewardship Council. The programme was pioneered in 1989, and joined by WWF and an insurance and banking company (OHRA) in 1993, when it gained great momentum and huge investments. The book offers an insight into the basics and credibility of forest management certification and forest products labelling and shows how the Internet helps to extract accountability from Trans National Corporations.

3776 Ryan, P.A. 1982. **The management of Burmese teak forests**. Commonwealth Forestry Review 61(2): 115-120.

Natural occurrence and physical conditions of Burmese teak forests are dealt with. Its vegetative associations, silvicultural characteristics and silvicultural systems followed in the Burmese teak forests are also dealt with.

3777 Salleh Mohd Nor; George, A; Tay, S.P. 2000. **High value timber species: Prospects and challenges**. Proceedings of the seminar on high value timber species for plantation establishment teak and mahoganies, Tawau, Sabah, Malaysia, 1-2 December 1998. H.H. Chan; K. Matsumoto, Eds. JIRCAS Working Report 16: 7-16.

Discuss the supply and demand of high-value timber, from the point of view of supplier countries in SE Asia such as Malaysia and Indonesia. Economics associated with initiating and financing plantation projects are discussed.

3778 Sardar, M.G; Deshmukh, A.P; Chandnani, K.N. 1997. **Projections of financial returns in the teak plantations in West Chanda Forest Project Division**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 216-221. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

The paper highlights the different projections of financial returns in teak plantation from thinnings proposed at various stages and which contribute revenue to the Forest Development Corporation of Maharashtra Ltd. The projections reveal that the short rotations are economically more profitable than longer rotations.

3779 Sarlin, P. 1961. **The teak plantations of Togo**. (French). Centre Technique Forestier Tropical, Nogent-sur-Marne: 31p.

Plantation technique, yields, financial returns and usefulness to the local population.

3780 Sathe, P.G; Susaeta, E. 1973. **Formulation and economic assessment of an intensive forestry project in eastern Maharashtra**. 211p. Ford Foundation, New Delhi.

Reports a feasibility study to assess by cost/benefit analysis of managing the large area of neglected forests in south-eastern Chandrapur District. Recommendations include intensive management to exploit and market existing forest produce as economically as possible, and the establishment of mixed plantations of *Tectona grandis*, semal and bamboo on a 50-year rotation.

3781 Saw Eh Dah. 2003. **Sustainable management of teak in Myanmar**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Teak from the natural forests has been a major source of foreign exchange earning for Myanmar for many years. After almost a century and a half of scientific and systematic management with the application of the Myanmar selection system (MSS), the natural teak bearing forests remain in comparatively good extent. With the application of time proven techniques and innovative modern methods, large scale plantations are established on depleted forest lands complementary to the main effort in natural forest management.

3782 Schmidt, P; Wiersum, K.F; Lemckert, D. 1997. **Collaboration between forestry, environment and trade; does the end justify the means?** Nederlands Bosbouwtijdschrift 69(2): 83-86.

Silvicultural and extension aspects are outlined on private investments in teak plantations in Costa Rica.

3783 Schmincke, K.H. 2000. **Teak plantations in Costa Rica - precious woods' experience**. Unasylva 51(201): 29-35.

An account of a commercial enterprise Precious Woods, a predominantly Swiss company operating in Costa Rica aiming to meet the rising demand for teak whilst contributing to sustainable forest development.

3784 Scott, C.W. 1945. **Burma teak today**. Wood 10: 81-84.

Burma provides about two-thirds of the world's output of teak, the total output from that country being about 1/2 million tons of round logs per annum. Half of this outturn comes from the Pegu Yomas between the Irrawaddi and Sittang rivers, before the Japanese invasion, was almost entirely reserved forest and worked on sustained-yield basis by lessees or the Government department. Owing to the vastness of the teak forests and to the lack of transport facilities, it is probable that the Japanese will have done little harm to the main Burmese teak stands.

3785 Sekar, C; Swaminathan, C; Surendran, C. 1993. **Economic analysis of silviagriculture in Tamil Nadu - a comparative study**. Range Management and Agroforestry 14(2): 219-224.

A diagnostic questionnaire survey was conducted of tree growing farmers in Periyar District, Tamil Nadu, to compare the costs and returns from silviculture and agrosilviculture. The agrosilvicultural systems were the most profitable, and provided a sustained income.

3786 Seth, V.S; Kohli, I.S; Jain, C.S. 1978. **A performance appraisal of Madhya Pradesh State Forest Development Corporation through accounting ratios**. Indian Forester 104(12): 797-818.

The Corporation was set up in 1975, with capital from the Central and State Governments. It has been concerned with the establishment of teak and bamboo plantations and a research and development project and a feasibility study on the establishment of forest-based industries. The Corporation's accounts for the three years to 1978 are presented.

3787 Shebbeare, E.O. 1921. **The Bomanpokri teak plantation**. Indian Forester 47(5): 224-226.

With reference to Gamble, the present condition of Bomanpokri teak plantations and an account of the operations carried out is given.

3788 Shyam Sundar, S; Parameswarappa, S. 1997. **Intensive management of teak plantations**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 20-23. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

In Karnataka, about 125,000 ha is under teak plantations of different age gradations. The current average price for good teak logs is Rs.24,500/m3. In teak plantations, the investment comes around Rs.7500/ha in the first year and then Rs.200 to Rs.500/ha in the ensuing years. It is high time to think about to increase the production and productivity of teak stands, managed by the State Forest Department. Measures to be undertaken for improving the production of existing teak stands are suggested. Formation of a Forest Corporation for teak and entrusting it the management of whole teak plantations is proposed.

3789 Simon, H. 1997. **History of teak forest management in Indonesia**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 52-60. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

The experiences gained from the teak forest management in Java, paved the way for development of forest management in Indonesia. Due to economic reasons, the management of teak forest in Central and East Java provinces was under the control of a state owned enterprise, Perum Perhutani, since 1972. The paper highlights the history of management of teak forest under different regeneration systems, viz., overstraten's report or first guideline, Daendel's regulation, Reglement 1829 or third guideline, Blandong system or natural system (fourth guideline), tumpangsari, etc. Also discusses the formulation of guidelines on operational thinning, final harvest, etc.

3790 Singh, J.A. 1959. **Teak forests and their management in Bombay State**. Proceedings of All-India Teak Study Tour and Symposium, December 1957-January 1958, Dehra Dun: 73-75.

3791 Snepvangers, F.W. 1929. **The economic significance of teak forests**. Tectona 22: 215-222.

3792 Soemarso. 1955. **The stand quality factor used in teak forest**. (Indonesian; English). Rimba Indonesia 4(1/2): 38-44.

Outlines a method to determine quality factors of a stand by comparing that with a normal stand at the end of the rotation. Since quality factors of a stand is not influenced by thinnings, this can be used to evaluate and appreciate the main crop.

3793 Srisuko, M. 1977. **Cost and profit estimation in the government's teak plantations**. (Thai). National Forestry Conference, Bangkok: 63-69. Royal Forest Department, Ministry of Agriculture and Cooperatives, Bangkok.

3794 Stebbing, E.P. 1947. **The teak forests of Burma**. Nature 160(4076): 818-820.

A history and valedictory to the forest administration with a warning to the Burmans of their responsibilities.

3795 Steber, B. 1998. **Marketing of teak**. Proceedings of the Seminar on High Value Timber Species for Plantation Establishment - Teak and Mahoganies, Sabah, 1-2 December 1998. JIRCAS Working Report 16: 83-89. H.H. Chan; K. Matsumoto, Eds.

Discussed from the point of supplies of plantation teak from South East Asia, including financial aspects of the marketing, investments as well as harvested teak timber.

3796 Subramanian, K; Mandal, A.K; Rambabu, N; Mammen, C; Nagarajan, B. 1999. **Site, technology and productivity of teak plantations in India**. Technical Bulletin IFGTB-99-1: 11p. Institute of Forest Genetics and Tree Breeding, Coimbatore.

This paper gives an account of teak plantation establishment in different rainfall and soil conditions, the agencies involved in the cultivation of teak and the productivity of the plantations projected by different owners in India.

3797 Sudarmo, M.K. 1957. **System of management for teak in Indonesia**. FAO Teak Sub-Commission, Bandung FAO/TSC-57/22: 2p. FAO, Rome.

Discusses methods of yield regulation, rotation etc.

3798 Sudiono, J. 1991. **An analysis of teak forest existence in Perum Perhutani**. (English; Indonesian). Duta Rimba 17(127/128): 2-18.

An account of teak production forests managed by Perum Perhutani in Indonesia, discussing management, inputs and outputs.

3799 Suksawasdi, S. 1953. **The future of Siamiese teak forests**. (Siamese). Vanasarn 11(2): 5-14.

Deplores the drain on the country's teak forests, points to the chief causes as uncontrolled forest clearance for shifting and permanent cultivation, fires, and illicit felling and suggests remedies.

3800 Tewari, D.N; Susaeta, E. 1973. **Formulation and economic assessment of an intensive forestry project for the Bastar region of Madhya Pradesh**. 47p. Ford Foundation, New Delhi.

Reports a feasibility study of forest development in the region involving improved management of existing forests. Forest inventory and resource data are presented, and an economic assessment is made of the profitability of existing natural stands and plantations including *Tectona grandis*.

3801 Thangam, E.S; Bhadran, C.A.R. 1959. **Teak forests and their management in Madras State**. Proceedings of All-India Teak Study-tour and Symposium, December 1957-January 1958, Dehra Dun: 80-92.

3802 Tint, K. 1999. **Socio economic and environmental conservation potentials of special teak plantation**. (Myanmar Language). Forest Department, Myanmar.

3803 Trevor, C.G. 1924. **A review of the Indian forest management III. Teak**. Indian Forester 50(7): 388-390; Empire Forestry Journal 2(1923).

The method of teak regeneration by clearfelling followed by artificial regeneration with field crops is described and regulation of yield are discussed.

3804 Unwin, R. 1912. **Teak in Togo**. Government Report, West Africa.

3805 Varmola, M.I; Carle, J.B. 2002. **The importance of hardwood plantations in the tropics and sub-tropics**. International Forestry Review 4(2): 110-121; 165-167.

The importance of tropical and subtropical hardwoods in industrial wood production in relation to market opportunities are discussed. Indicative estimates of teak standing volume annually available are presented showing Asia dominating production. Recommendations are made for promoting the establishment of hardwood plantations in the tropics and sub-tropics.

3806 Venkataramana Iyer, K.R. 1932. **Inspection notes of Tinnavelly Division, Madras**. Madras Forest Department.

3807 Walker, H.C. 1919. **The management of teak forest**. Indian Forester 45(11): 561-578.

The Burma experience is discussed and present practice of converting all mixed teak forests to even aged woods is criticised.

3808 William Logan. 1889. **A collection of treaties, engagements and other papers of importance relating to British in Malabar**. Government Press, Madras: 319p.

3809 Wind, R. 1928. **The economic importance of Java teak forests**. Tectona 21: 459-506; Roundschau 1: p350.

3810 Winkle, R van. 1920. **A teak plantation**. Indian Forester 46(6): p318.

Details of growth figures of a plantation in Palamau division, Bihar are given.

3811 Wiroatmodjo, R.S; Effendi, R.M. 1955. **Financial rotation of teak and profit**. Rimba Indonesia 4(6-8): 249-259.

Calculations have proved that the financial rotation of teak with a higher rate of interest is short. To put this into effect a sound forestry technique and its social function have to be taken into full consideration.

3812 World Bank, Washington. 1976. **Social cost benefit analysis: A guide for country and project economists to be derivation and application of economic and social accounting prices**. World Bank Staff Working Paper 237: 142p. World Bank, Washington.

3813 Wyatt Smith, J. 1945. **The Ibadan fuel plantations**. Farm and Forest 6(2): 95-99.

Teak has been the principal species planted with other species on slopes. Revenue and establishment costs are discussed.

Go top

Management

(See also 1947, 2293)

3814 Boomgaard, P. 1992. **Forest management and exploitation in colonial Java, 1677-1897**. Forest and Conservation History, USA 36(1): 4-14.

3815 Browne, R.S. 1929. **Revised working plan for the Nilambur Valley 1928-29 to 1937-38**. Madras Forest Department.

3816 Centeno, J.C. 1997. **The management of teak plantations**. Tropical Forest Update 7: 10-12.

3817 Champion, H.G. 1962. **Report to the Government of Thailand on a working plan for the Mae Ngao forest**. Expanded Technical Assistance Program Report 1540: 111p. FAO, Rome.

Deals with proposed forest management including working plan for teak working circle, silviculture, yield regulation, stand regeneration and forest protection. Includes recommendations to Government.

3818 FAO. 1957. **Note on production of teak: Indonesia**. FAO Teak Sub-Commission, Bangkok FAO/TSC-57/20: 2p.

Gives trend of production from 1938 to 1956 and suggestions are provided for increasing production through replanting unproductive stands, retionalization of the maintenance and protection of plantations, conversion of rejected wood left unused in forest by sawmills and using the waste of cutting areas, ie., branches and trunks and at sawmills for hardboard and chipboard.

3819 FAO. 1967. **Production outlook for teak in Burma**. FAO Teak Sub-Commission, Rome FAO/TSC Rome FO:T/67/6: 5p.

The ecological requirements of teak are stated and the total planted area so far is 95,000 acres pure and 15,000 acres in mixture and its rotation is 40-60 years. Natural teak forests managed on sustained yield basis on selection system on a 30 year cycle, with a yield of 450,000 tons and 90 percent of this is exported. Measures to increase production are suggested.

3820 FAO. 1967. **Production outlook in the old teak growing countries**. Asia-Pacific and African Forestry Commission, Teak Sub-Commission, Rome FO:T 67/7: 12p.

Natural teak forests occupy about 13 percent of total forest areas of India. Its climatic conditions, classification of teak forest types, soil and nutrient requirements, international provenance trials, progress in seed orchard work, management, logging and transport methods are discussed. Utilization of teak and mechanization problems are outlined and current and future research programmes are indicated.

3821 FAO. 1985. **Intensive multiple use forest management in the tropics**. FAO Forestry Paper 55. FAO, Rome.

3822 FAO. 1986. **Special study on forest management, afforestation and utilization of forest resource in developing regions, Asia-Pacific**. APM Case Study, Bangkok, Thailand, Field Document 12(2). FAO Regional Office for Asia and the Pacific.

3823 Gyi, K.K. 1995. **Management status of natural teak forests**. Proceedings of the 2nd Regional Seminar on Teak, Yangon, Myanmar 29 May-3 June 1995.

3824 Hopwood, S.F. 1932. **On teak plantation in Burma**. Annual progress report of Forest Administration in Burma 1931-32: 279p.

Describes forests, so far reserved and fire protection measures adopted with costs. Teak is planted in 2200 acres.

3825 Houaye, P. 1993. **Variability of teak plantations in Benin**. (German). Gottinger Beitrage zur Land und Forstwirtschaft in den Tropen und Subtropen 85: 170p. Institut fur Pflanzenbau & Tierhygiene in den Tropen & Subtropen, Gottingen, Germany.

The biological and ecological features of teak are reviewed, and details given of the extent and management of the teak stands in Benin. Detailed investigations were made of the development and variation of individual-tree parameters and stand parameters in plantations on two sites. The results confirm the unsatisfactory structure of the Benin stands.

3826 Kartosoedarmo, M. 1956. **Management system of teak forest**. Country Report on Teak. FAO, Rome.

3827 Kesarcodi, S.N. 1934. **Revised working plan for the Haliyal teak pole forests of Kanara North Division**. Government Printing, Mysore and Mysore Forest Department.

3828 Koelmeyer, K.O. 1957. **Teak plantations in Ceylon**. Ceylon Forester 3(2): 178-184.

Includes climatic and site data, methods of formation, injuries, and volume tables for existing plantations totaling ca. 9100 acres.

3829 Kolison, S.H, Jr; Granskog, J.E; Walker, R; Busbu, R.L. 1997. **Institutional and economic factors influencing the management of teak plantations in the Republic of Trinidad and Tobago**. Asia Life Science 6(1/2): 16p.

3830 Kyaw, S. 2000. **Historical review of teak forestry in Myanmar**. Proceedings of the 3rd Regional Seminar on Teak, Yogyakarta, Indonesia, 31 July-4 August 2000.

3831 Lushington, A.W. 1896. **Report and working scheme of the Nilambur teak plantations**. Kerala Forest Department, Trivandrum.

3832 Mammen, C. 1993. **History of forest management in Kerala**. KFRI Research Report 89: 114p. Kerala Forest Research Institute, Peechi.

An attempt has been made to discern the main trends in forest management in Kerala. Three broad phases in forest management has been identified and they are the rise of forestry, the period of turbulence and change and the ascent of conservation. The major achievements during the period of the rise of forestry are the reservation of forests, the perfecting of teak planting techniques and initiation of systematic management on the basis of carefully prepared working plan.

3833 Mammen, C. 2001. **Economics of forest plantations in Kerala**. KFRI Research Report 210: 50p. Kerala Forest Research Institute, Peechi.

The study examined the productivity and profitability of different forest plantations in Kerala. Teak plantation managed on a mean rotation of 58 years is reported to have the mean annual increment of 2.516 m3 ha(-1)year(-1). The internal rate of return of teak plantations was 25.9 per cent.

3834 Martin, B; Kadio, A; Offi, K. 2000. **Towards intensive management of teak plantations in Cote D'Ivoire**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 151-160. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

Teak management has been modernized, vegetative propagation techniques allowing rapid use of superior clones have been introduced, management of existing plantations has been improved and restocking after final harvesting has been accelerated. Discussed the present status of teak plantations and intensive management of existing plantations and intensification of new plantation establishment in Cote-D'Ivoire.

3835 Mobbs, E.C. 1941. **The early history of Indian forests**. Indian Forester 67(1): 241p.

3836 Mungkorndin, S. 1970. **On the management of teak forests and other non-teak forests in Thailand**. (Thai). Proceedings of 3rd National Forestry Conference, Royal Forest Department, Bangkok: p79.

Describes intensive measures undertaken in recent years for the management of teak forests in the interest and as per requirements of National development plan.

3837 Nagdev, D.P. 1949. **Nilambur teak forests: The plantation of my delight**. Indian Forester 73(2): 467-468.

A brief historical background of the Nilambur teak plantation is given and described the regeneration technique.

3838 Nair, C.T.S; Mammen, C; Muhammed, E. 1984. **Intensive multiple use forest management in the tropics: A case study of the evergreen forests and teak plantations in Kerala**. KFRI Research Report 22: 184p. Kerala Forest Research Institute, Peechi.

Deals with the management of the evergreen forests and teak plantations in Kerala. The two major types of forest that occur in the study area are evergreen forests and moist deciduous forests. Evergreen forests are worked for wood production under a selective felling system. Moist deciduous forests are converted into teak plantations by clearfelling. Most of the teak plantations contain a large number of commercially valuable species. Teak plantations are raised under the taungya system in which cultivators undertake all the post-planting operations for a period of about two years.

3839 Nair, C.T.S; Mammen, C. 1985. **Forest management system in the tropical mixed forests of India**. FAO Forestry Paper 89. FAO, Rome.

3840 Nair, C.T.S; Souvannavong, O. 2000. **Emerging research issues in the management of teak**. Unasylva 51(201): 45-54.

The evolution of priorities and institutional arrangements for research on teak management and utilization is discussed in the context of changing management scenarios and the increasing involvement of the private sector.

3841 Nath, B; Chittranshi, V.N. 1967. **Impact of intensive forest management on the growth behaviour of teak in the teak high forests of Narshimpur Forest Division, Madhya Pradesh**. Proceedings of the 11th Silvicultural Conference, Dehra Dun 1967, Item III.C.(1). Forest Research Institute, Dehra Dun.

An attempt is made to correlate past treatments on the growth rates of converted and unconverted teak in the teak high forests of Narshimpur forest division of Madhya Pradesh. The converted teak contains a series of normal age gradations upto thirty eight years showing the effect of past management practices. The unconverted teak did not receive any intensive management during early 30-40 years of development and forms the basis of comparison of the growth factors of converted teak.

3842 Niemmich. 1896. **Management of teak in Java**. Zeitschrift fur Forst. U-Jagdwesen 28: 714-721.

3843 Nieuwenhuyse, A; Hengsdijk, H; Bouman, B.A.M; Schipper, R.A; Jansen, H.G.P. 2000. **Can forestry be a competitive land use option? Model simulations from humid tropical Costa Rica**. Forest Ecology and Management 137(1/3): 23-40.

Model simulations were carried out to study options for managed natural forest and *Gmelina arborea* and teak plantations, on land suited for agriculture in the humid tropical Atlantic lowlands of Costa Rica. The results indicated that teak and gmelina plantations are attractive land use options, while managed natural forest is not.

3844 Nonhare, B.P. 2003. **Maniram teak plantation 1891 - a state heritage of Chattisgarh**. Indian Forester 129(5): 661-662.

The history of the teak plantations dates back to 1891 which is the oldest teak plantation of Chattisgarh state. Shri Maniram Gond then the forest guard during British rule was the person responsible for raising this plantation. In honour of the late dedicated forester, The Forest Department of Madhya Pradesh named the plantation as Maniram Teak Plantation 1891. The estimated value of teak trees of this plantation comes to Rs.2,05,53,000.

3845 Pakpahan, A; Ismuyatmono, Y. 1982. **Absorption of labour in teak forest management in Cepu forest District**. (Indonesian). Duta Rimba 8(52): 41-43.

3846 Peluso, N.L. 1991. **The history of state forest management in colonial Java**. Forest and Conservation History 35(2): 65-75.

The control of forest land, teak and labour is discussed in relation to the two main periods of Dutch influence and rule, the mid-17th century to 1799, when much of Java was under the influence of the United East India Company and 1814-1940, when Java was ruled by the Dutch colonial state.

3847 Petty. 1933. **Thana Malki teak working plan, Bombay**. Government Report, Forest Department, Bombay.

3848 Porter, H.J. 1895. **The management of forests containing teak**. Indian Forester 21: 141-142.

The rapidly grown moisture teak of Nilambur and slow grown dry Annamalai hill teak forests are compared and the problems of silviculture and management of these plantations are discussed.

3849 Prabhu, H.N. 2001. **New management options for improving the productivity of teak plantations in Kerala**. Tropical Forestry Research: Challenges in the New Millennium. Proceedings of the International Symposium, Peechi, India, 2-4 August 2000. R.V. Varma; K.V. Bhat; E.M. Muralidharan; J.K. Sharma, Eds: 165-167. Kerala Forest Research Institute, Peechi.

The paper discusses the reasons for declining productivity, steps for improving the same and the latest measures taken by the Kerala Forest Department to improve the productivity of teak.

3850 Prasad, R.S.R. 1995. ***Tectona grandis* - elite management**. Indian Forester 121(6): 558-562.

Data are presented and discussed on the commercial management of teak plantations and its financial aspects in India.

3851 Pratiwi; Lust, N. 1994. **Teak (*Tectona grandis* Linn.f.) forests in Java, Indonesia. Plantations, management and policy**. Silva Gandavensis 59: 97-118.

An overview is given of forest policy and management, environmental conditions, silviculture, distribution and area of teak forests in Indonesia. The taungya system and a daily wage system are both considered to be valuable social and economic factors for people in areas surrounding teak forests. Indirect government policies as well as those aimed at teak forest resources, could also help to maintain teak forests and production in Indonesia on a sustainable basis.

3852 Rahman, A. 1982. **The strategy of long-term programming for teak plantations in Bangladesh**. Bano Biggyan Patrika 11(1/2): 48-55.

Various yield data are given and compared with those for other countries, against which Bangladesh teak rates poorly. Based on rates of return it is concluded that teak should not be planted on sites of site index 30. The estimated teak requirement by 2040 is about 5 percent of the total expected yield from the hill forests. Five strategies with respect to sites, plantation area, rotation, thinning and stocking are outlined to give a long-term programme consistent with socio-economic goals and national forest policy.

3853 Ramakrishna, A. 1956. **Teak in Nallamalais**. Andhra State Souvenir of Andhra Pradesh State Forest Department, Hyderabad: 65-68.

Gives a short description of the forests and the method of raising plantations.

3854 Ramakrishna, A. 1957. **Progress of teak plantations in the Nallamalais during the last half a century and their future**. Indian Forester 83(7): 462-464.

Indicated briefly the general requirements of teak for soil, climate etc. The progress made in raising teak plantations in Nallamalais, Andhra Pradesh has been discussed. Importance of fire protection elucidated.

3855 Ranganathan, P.B. 1982. **Seventh working plan for the Nilambur Forest Division,**

1982-1983 to 1991-1992. Kerala Forest Department, Trivandrum.

3856 Samapudhi, K. 1957. **The forests of Thailand and forestry programmes**. Royal Forest Department, Bangkok R.20: 35p.

3857 Schirie, A. 1961. **The achievements of the forest service in the province of Majunga (Madagascar)**. (French). Centre Technique Forestier Tropical, Nogent-sur-Marne: 12p.

A brief account of the afforestation using the species which include teak and the erosion control.

3858 Simon, H. 1989. **Social forestry as a tool for management of teak forests near heavily populated areas: A case of Java**. Southeast Asian Regional Center for Graduate Study and Research in Agriculture, Philippines: 193-207.

3859 Simon, H. 2000. **The evolvement of teak forest management in Java, Indonesia**. Potentials and opportunities in marketing and trade of plantation teak: Challenge for the new millennium. Proceedings of 3rd Regional Seminar on Teak, Indonesia, 31 July-4 August 2000: 83-90. E.B. Hardiyanto, Ed.

3860 Soemaatmadja, S.A.S. 1982. **Teak forest conservation in Perum Perhutani's working circles**. (Indonesian). Duta Rimba 8(53): 9-17.

3861 Soemaatmadja, S.A.S. 1982. **The sustained yield of teak forest management in the Perum Perhutani area**. Forest Magazine of Perum Perhutani, Jakarta 53.

3862 Strugnell, E.J. 1932. **The teak forests of Java**. Empire Forestry Journal 11: 34p.

3863 Varmah, J.C. 1976. **Forest management in Andamans**. Indian Forester 102(2): 73-85.

Briefly describes the eleven forest types in the Andaman Islands, the history of forest management, artificial regeneration of plantation species and the natural regeneration of evergreen and deciduous forests. The potential production of some Andaman timbers, trends towards more intensive forest management, and the effects on the environment of the increased activity are discussed.

3864 Wardono Saleh; Fattah, H.A; Poedjoraharjo, D.S. 1997. **Culture of teak plant by Perum Perhutani**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 12-14. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Perum Perhutani, a state-owned enterprise of Java, Indonesia, has 600,093 ha of teak forest under its management. Per annum production of teak is about 700-800 m3. 'Thumpangsari' and 'Banjar harian' planting systems are practised for raising teak plantations. Fast growing multipurpose tree species are raised along with teak plants to prevent soil erosion, preserve soil fertility and to protect against pests, diseases and external interferences. Methods of regeneration of teak, preservation and thinning, and problems confronted in teak plantation management are highlighted.

3865 Watson, H.W.A. 1916. **Teak working plans in Burma 1. Past working plans**. Indian Forester 42(1): 4-17.

The basis of proposals in the past were described and critically examined and probable trend in the future working plans is outlined. The details of working under girdling system and regeneration artificially of teak in bamboo flowered areas is discussed and suggestions are made.

3866 Winters, R.K. 1975. **Forestry beginnings in India**. Journal of Forest History 19(2): 82-90.

An account of the history of the public forest administration and forestry education upto 1947, emphasizing the importance of the teak trade in the creation of the administration and of Indian forestry as the first major expansion of professional forestry outside Germany and France and into the tropics.

Go top

Marketing

(See also 3743, 3956)

3867 **Reduction of the duty on teak timber brought down to Moulmein from foreign territory**. Indian Forester 7, 1882: 330-333.

3868 **Teak wood**. Indian Forester 9, 1883: p583.

Gives an account of the good qualities of teak wood and recommends its use for a variety of purposes and requirements of wood.

3869 **The further development of the teak trade**. Indian Forester 14, 1888: 282-285.

3870 **The teak trade**. Indian Forester 18, 1893: p401.

Gives export figures of teak from Moulmein to Western Europe and Middle East mainly U.K., West Europe and Egypt.

3871 **The teak trade of Chiangmai**. Indian Forester 19, 1893: 39-41.

The outlet for Chiangmai teak timber is through Bangkok and Moulmein. The problems of trade are discussed.

3872 **The teak trade in Siam**. Indian Forester 21, 1895: 431-432.

Gives an account of extraction and floating methods adopted in the principal teak bearing forests of Siam. The method of extraction and transport and problems of rafting, seasons and theft of rafts are also discussed.

3873 **The teak trade of Chiangmai in Siam for 1894**. Indian Forester 21, 1895: 12-15.

Gives quantitative figures of extraction and export of teak wood from Chiangmai and also discusses problems encountered.

3874 **Consumption of teak in Europe**. Bulletin Soc. For., Belgium 5, 1898: p50.

3875 **Teak and the French timber trade**. Bulletin Soc. For., Belgium 6, 1899: p431.

3876 **Teak trade in Bangkok, Siam during 1898**. Indian Forester 26(2), 1900: 96-97.

3877 **Teak timber exports**. Indian Forester 32(8), 1906: p422.

A short note on the export figures of teak from India, Burma, Siam and Java.

3878 **Note on trade of teak timber in Netherlands**. Tectona 4, 1911: 752-763.

Gives production and teak trade from 1899 - 1908-09.

3879 **East India teak**. Indian Forester 41(5), 1915: 169-170.

The note describes the impact of world war I on teak trade.

3880 **Teak and other curls or crotches**. Indian Forester 57(5), 1931: 234-237.

A note received from Timber Adviser to the High Commissioner of India on the possibilities of working up a trade in curls of teak and other Indian timbers with observations and remarks by M/s. Leary and Company.

3881 **On net price of teak: Bori forests, Hoshangabad**. Forest Research in India and Burma 1941/42, Part I, 1943: p151.

Investigations have shown that the net price per cu.f. for teak in the Bori for forest of Hoshangabad division varies directly with age and size of tree; the prices per cu.ft. continues to increase with age upto 120 years.

3882 **Burma teak exports**. Timber Trade Journal 243(4499), 1962: p62.

The Director, Marketing and Milling of the State Timber Board, Rangoon, presents the exports to 19 countries in tons.

3883 Altona, T. 1922. **New Guinea teak and no Hindoos**. (Indonesian; English). Tectona 15: 612-621.

Teak has been found up to end of the 19th century in New Ireland and in South Papua. Since climate is not favourable for natural growth of teak in the locality and the Hindoos traveled to these places, teak is considered to be imported there by Hindoos.

3884 Anuwatanawanaraksa, P. 1967. **Duty-fees paid on each teak tree**. (Thai). Proceedings of the First Forestry Conference, Royal Forest Department, Ministry of Agriculture, Bangkok 107: 5-6.

The author discusses the exploitation of teak wood from forests and the wastage involved in it. He recommended levying a special duty or fees on teak tree.

3885 Argal, A; Berry, N; Sood, L.K; Chawdhry, P.K; Shukla, P.K. 2003. **Timber trading trends in Madhya Pradesh**. Indian Forester 129(8): 1009-1012.

Results are presented of the study conducted to analyze the market price variation of seven timber species which include *Tectona grandis* .

3886 Baghel, L.M.S; Behari, B; Gupta, A. 1999. **Price trends of fuelwood: A comparative analysis of Madhya Pradesh and Maharashtra**. Journal of Tropical Forestry 15(4): 302-310.

Comparative price trends of fuelwood in markets in Madhya Pradesh and Maharashtra were studied by collecting price

data on a quarterly basis and estimating simple average quarter growth rates. The mean price and temporal character of variability exhibited the same phenomenon. Correlation coefficients between the markets showed that prices of fuelwood were highly correlated between the markets during the period under study. The price of teak fuelwood had the maximal increase over all three markets studied.

3887 Black, S.J. 1901. **Report on the teak trade in Chiangmai, Siam**. Indian Forester 27(3): 136-140.

The exports and output from 1899 compared with 1898 and causes of decrease in 1899 reviewed.

3888 Bracamp, E.H.B. 1916. **Why are the teakwoods of Manggar Telawa en Tanggoeng zoo cheaper ?** Tectona 9: 479-481.

3889 Brascamp, E.H.B. 1914. **Survey of the results of the 1st semester of 1914 etc., on teak trade and exploitation**. (Indonesian; English). Tectona 7: 873-885.

3890 Brascamp, E.H.B. 1915. **The Siamese teak wood trade again**. Tectona 8: 71-72.

3891 Brascamp, E.H.B. 1916. **An old method for teak trade in Siam**. (Indonesian; English). Tectona 9: 142-143.

3892 Brascamp, E.H.B. 1917. **The meaning of East India Company in relation to export trade of teak in 1790**. (Indonesian; English). Tectona 10: 581-583.

3893 Brascamp, E.H.B. 1919. **The contract of teak delivery by Denmark from 1673**. (Indonesian; English). Tectona 12: 386-390.

3894 Butterwick, A.J. 1915. **Teak after the war: Teak wood**. Indian Forester 41(12): 503-504.

Quoting from scientific American reports increased utilization of best grade teak for construction of modern war ships lost in war and supplies from both Burma and Siam cannot meet this demand, hence prices are going to be up.

3895 Carlisle. 1901. **The teak trade of Bangkok and district**. Indian Forester 27: 187-190.

Giving export market of teak for last 10 years, discusses the prospects and problems of export trade.

3896 Chepsithar, S. 1955. **Thailand teak exports**. Bangkok Chamber of Commerce Journal 9(3).

3897 Dah, Saw Eh; Baw, Shwe. 2000. **Regional marketing and trade**. Proceedings of the 3rd Regional Seminar on Teak, Yogyakarta, Indonesia: 1-4.

3898 De'ath, C. 1992. **A history of timber exports from Thailand with emphasis on the 1870-1937 period**. Natural History Bulletin of the Siam Society 40(1): 49-66.

The history of the Thai forests is largely the history of teak and other non-floatable hardwoods. This paper reviews how the Thai forest resource was depleted over the period 1870-1937. The tables are accompanied by information on the political, ecological and economic factors affecting production and exports during particular periods. A final overview assesses the effectiveness of certain forest policies and the role of the British in the exploitation process.

3899 Doorn, A van. 1926. **A note on the production and price policy for the Government teak exploitation**. (Indonesian; English). Tectona 19: 469-480.

The restriction of timber output in relation to price policy of Government Departments. Proposes a method of sub-division of costs: (a) raising of teak forests and maintenance, (b) cost of harvesting and discusses which costs are to be included under a and b, and (c) staff and need to analyse costs of working is stressed.

3900 Duyfjes, J.J. 1915. **The export of teakwood from Asia to Europe**. Tectona 8: 44-68.

3901 FAO. 1956. **Export and trade in teak of Thailand**. FAO Teak Sub-Commission, Bangkok FAO/TSC-56/2: 2p.

Statistical records after world war II show that teak production amounted to 295,000 cubic meters per year of which some 78,000 cubic meters are exported.

3902 FAO. 1957. **Note on trade of teak in Indonesia**. FAO Teak Sub-Commission, Bangkok FAO/TSC-57/21: 2p.

Trade figures and export quantities from 1938 to 1956 are given, with a note on the prevailing prices of 1956 for different items of use of teak.

3903 FAO. 1960. **Teak production, trade and prices: Note by the secretariat**. FAO Teak

Sub-Commission, New-Delhi FAO/TSC-60/5.1: 4p.

The production, trade and prevailing prices of teak in Burma, India, Indonesia, Laos and Thailand are given in tables, with suitable explanations.

3904 FAO. 2002. **Market for high value tropical hardwoods in Europe**. FAO, Rome.

3905 Gallant, M.N. 1957. **Teak wood trade. Report to the Government of Burma**. Expanded Technical Assistance Program, FAO, Rome 692, 74p.

Gives data on Far East Teak wood supply, geographic distribution, quality standard, production, supply and demand and describes the post-war potential, international markets and marketing.

3906 Glass, J.B. 1949. **The teak trade**. Review of Timber Development Association 2(6): 9-11.

3907 Glass, J.B. 1953. **The teak (Tectona) outlook**. Timber Trade Journal June 2: 85-86.

3908 Gyaw, U.O. 1949. **Burma teak lease**. Burma Market Review 3(3): 67; 69-71.

3909 Harding, L.O.B. 1950. **The Burma teak trade**. Timber Trade Journal 195(3875): 877-878.

3910 Hauxwell, T.A. 1905. **The teak timber trade of Burma**. Indian Forester 31(11): 618-635.

Discussing the diminished supply and high prices of teak over past two years, the author gives imports into Europe market of last 16 years (1889-1904) compared with total exports from Burma and Siam and considers increased export of Siamese teak to India is detrimental to Burma.

3911 Helles, F. 1973. **Denmark's supply of tropical timber**. (Danish). Traeindustrien 23(6): 50-56.

Presents results of an analysis of total imports and exports in the period 1961-70 of tropical round timber, sawn timber, veneer and plywood from Africa, Asia and Latin America, and a breakdown into mahogany, teak and other tropical hardwoods.

3912 Hofseus, C.C. 1907. **The teak trade in Siam**. Beiheft zum Tropenfflanzer, December 1907.

3913 Iamchandra, H. 1968. **Teak marketing condition in Thailand**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Source of production is mostly in northern Thailand and estimated the forest area, extraction, consumption and exports from the Thailand.

3914 Jen, I.A; Wu, W.Y; Chen, L.C; Tu, S.H. 1997. **An analysis of the current situation of the wood flooring market in Taiwan**. Taiwan Journal of Forest Science 12(4): 451-458.

The study analysed market characteristics and purchase attributes of wood flooring in Taiwan.

3915 Krishnankutty, C.N. 1989. **Long-term price trend of timber in Kerala**. Indian Journal of Forestry 12(1): 7-12.

An analysis of price trends at timber auctions in Kerala Forest Department depots from 1956-57 to 1984-85 showed that general trends were similar for the 8 species studied which include teak. The prices initially decreased slightly to 1966-69 and then increased until 1976-77, then increase rapidly.

3916 Krishnankutty, C.N. 1990. **Demand and supply of wood in Kerala and their future trends**. KFRI Research Report 67: 84p. Kerala Forest Research Institute, Peechi.

This study is an attempt to estimate the demand for wood by various sectors and supply from different sources in Kerala during the year 1987-88. Future trends in the demand and supply of wood upto the year 2004-05 are projected based on certain assumptions. Pattern of growing stock distribution of trees in homesteads is anlayzed to estimate the stock and to understand the species preference. Field surveys were carried out for estimating the quantity of wood used by households in rural areas for construction, furniture, etc., by small industries as timber, fuelwood and charcoal, by households in urban areas, teashops, restaurants, etc. as fuel; as well as for estimating the growing stock of trees in homesteads. Anjily, teak and matty are the species preferred among trees grown for wood.

3917 Krishnankutty, C.N. 1997. **Demand, supply and price of teakwood in Kerala**. Ph.D Thesis: 206p. Calicut University, Kerala.

3918 Krishnankutty, C.N. 1998. **Timber price trends in Kerala**. KFRI Research Report 160: 51p. Kerala Forest Research Institute, Peechi.

Statistics are presented on the price trends of species including teak in Kerala.

3919 Krishnankutty, C.N. 2001. Forecasting of teak prices in Kerala State, India using autoregressive

integrated moving average models. Indian Journal of Forestry 24(2): 119-122.

Based on time series of average annual current prices of teak in girth classes 1, 2 and 3 in Kerala State is studied. Future prices were predicted with 95 percent confidence limits for the years up to 2015-16 using autoregressive integrated moving average models.

3920 Krishnankutty, C.N. 2001. **Teak price trends in Kerala State, India**. Indian Journal of Forestry 24(1): 1-7.

This paper examines the long term trend in prices of teak in five girth classes in Kerala and compares the price trend with those of other timbers. The analysis showed that the real prices of teak and other timbers declined moderately during the period from 1956-57 to 1968-69. The prices again showed an increasing behaviour till 1983-84. The rate of increase was drastic during the period from 1977-78 to 1993-94. Since then, while prices of teak continued to increase, prices of other timbers showed a decline.

3921 Krishnankutty, C.N. 2002. **Factors influencing teak prices in Kerala**. Indian Journal of Forestry 25(1): 26-29.

The paper examines the factors that influence the long-term change in the real prices of teak sold in auction in the Forest Department depots in Kerala State. Autoregression analysis showed that the real price of teak in a year was closely related to its preceding year's real price, indicating a successive dependence which partly influence the trends in real prices. It was found that the real price was not related to the production of teak in the current year, but inversely related to one year lagged production. It indicates that a reduction in production in the previous year follows an increase in the current year's real price.

3922 Kunsi, E.D; Wechel, G.L Te. 1924. **Combined corporations for the wholesale trade of teak in Java**. (Dutch; German; English). Tectona 17: 141-150.

A combined corporation incorporating timber traders and Government is suggested for the whole of output of the teak fellings in Java. The combination may contribute to saving of forestry personnel in storage and sale of timber to private business.

3923 Latham, B. 1954. **The growth of teak trade. 1. The forests of Western India**. Wood 19: 371-373.

3924 Latham, B. 1954. **The growth of the teak trade 2. Establishment of plantations**. Wood 19: 415-417.

3925 Latham, B. 1954. **The growth of the teak trade. 3. The mid-nineteenth century**. Wood 19: 451-453.

3926 Latham, B. 1954. **The growth of the teak trade. 4. Burma and Siam**. Wood 19: 504-506.

3927 Latham, B. 1957. **Timber, its development and distribution: A historical survey**. G.G Harrap and Company Limited, London: 303p.

Contains sections on the use of timber and the timber trade from ancient Egypt to the present day, the Baltic, U.S.A. and Canada, the Spanish main and mahogany, teak and the E. India Company, oak, sawmilling, the carpenter, timber houses and halls, wooden ships.

3928 Merton, C.G. 1903. **Hardwood marketing - report to the Government of Indonesia**. FAO/EPTA Report 1661. FAO, Rome.

Gives recommendations on wood grading and deals with teak on economics of log transportation and wood processing. Reviews the present domestic and export and its development.

3929 Moonrasarn, S. 1992. **Thailand's teak: Import and export 1982-1991**. Proceedings of the Seminar on 50 Anniversary of Huay-Tak Teak plantation, Bangkok, 5-8 August 1992.

3930 Niloufari, P; Tamolang, F.N. 1979. **Evaluation of tropical woods in the Iranian market**. Wood quality and utilization of tropical species. Proceedings of IUFRO conference, Laguna, 30 October-3 November 1978: 157-163. Forest Products Research and Industries Development Commission, Laguna, Philippines.

Trade names, source, appearance, physical and mechanical properties, and uses are tabulated for sixteen tropical timbers including teak imported into Iran.

3931 Rahman, A. 1981. **Price-size relationship and rate of return from teak plantations in Bangladesh**. Bano Biggyan Patrika 10(1/2): 44-48.

Two regression equations were tested to explain price changes in response to size variation in teak logs, using data from randomly selected teak merchants in Chittagong.

3932 Rai, S.N. 1987. **Steep rise in timber prices**. Myforest 23(1): 111-115.

Data are presented showing prices obtained for timber sales of 10 important species including teak from 1970 to 1985, at Dandeli, one of the major timber depots in Karnataka. Strong recommendations are made for increased wood production, increased efficiency of utilization and preservation of wood already in use.

3933 Soedihardjo, E. 1977. **The conditions of raw log materials and their influence on export yield of teak sawn timber**. (Indonesian; English). Duta Rimba 3(18): 14-25.

3934 Somaiya, R.T. 2003. **Teak wood trade in India**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Since 1982, when cutting of teak from native forests was restricted, Indian processing enterprises and traders have been depending on imported teak logs. Currently, West African and Central American countries have been the major suppliers of plantation teak. And there has also been a shift from teak to other durable hardwoods. It is suggested that if quality of teak timber from sustainable sources does not improve, the market will shrink further to the detriment of teak trade in India as well as overseas. Plantation technology needs to be reviewed to get better quality of wood from teak plantations.

3935 Suri, S.K. 1973. **Comparative price trend studies of five commercially important timber species logs - Narainpur depot (Madhya Pradesh)**. Indian Forester 99(8): 510-515.

On the basis of prices obtained during auctions at Narainpur depot, price trends for second-grade timber logs of *Tectona grandis* and other species are compared and discussed. Results showed that logs of *T. grandis* fetch much higher price than logs of the other species, and also that there is a definite trend in price increase with increase in girth for all species.

3936 Suri, S.K. 1974. **Price trend studies of teak logs, Taku Depot (Madhya Pradesh)**. Indian Forester 100(4): 235-245.

An attempt was made to analyse price trends for second-grade logs of *Tectona grandis*, based on data from auctions at Taku Depot in 1970-71 and 1971-72.

3937 Tewari, D.N. 1995 . **Marketing and trade of forest produce**. 140p. International Book Distributors, Dehra Dun.

Marketing and trade of different species including teak is dealt with.

3938 Thirawatana, S. 1954. **The position of timber exports from Thailand**. (Siamese). Bulletin of Royal Forest Department, Ministry of Agriculture, Bangkok R.15: 190p.

A detailed account of timber exports from Thailand is given which also include the following topics: quantity of teak exported compared with other species, present demand for hardwoods and comparison between the characteristics of Thai and foreign timbers.

3939 Tiffani, F. 1926. **Indian teak exports**. Indian Forester 52(10): 538-540.

Reports majority of exports from Indian ports are teak and comments on specific superior characteristics of teak over native timbers.

3940 Timber Industry Development Division, Ghana Forestry Commission. 2003. **Report on export of wood products, March 2003**. Timber Industry Development Division, Ghana Forestry Commission.

3941 Tottenham, W.F.L. 1905. **The teak trade and forest conservation in Siam**. Indian Forester 31(8): 464-471.

3942 Varangis, P. 1990. **How integrated are tropical timber markets?** International Economics Department, World Bank, Policy, Research and External Affairs Working Papers WPS 465: 25p.

Data were analysed to test whether in the long run tropical timber prices move together in spite of multiple species and products, and regional trade patterns. Time series of data covering 1956-1963 to 1989 were tested for logs of species including teak.

3943 Warta, A.J. 1926. **Export of teak (*Tectona grandis* Linn.f.) from the Netherlands In-**

dies, British India and Siam. (Dutch; English). Tectona 19: 151-169.

A comparison of the export of teak from the three countries is made.

3944 Warta, A.J. 1927. **Position of Java teak on the world market**. (Dutch; English). Tectona 20: 36-53.

Discusses the factors responsible for lowering of the export trade of teak in Java.

3945 Westra, J.G. 1930. **The sale of teak thinnings**. (Dutch; English). Tectona 3: 641-658.

Go top

Wood Industry

(See also 4394)

3946 **Teak industry of Siam**. Indian Forester 27(10), 1901: 529-533.

The teak industry of Siam between Menam and Mekong rivers in Northern Siam is described, together with details of extraction and transport.

3947 **The teak industry of Siam**. Imperial Forestry Institute Bulletin 26, 1928: p102.

Review of the book by the Government of Siam, Department of Commerce and Communications which describes the condition of teak forests of Siam together with the history of the industry.

3948 **The teak industry of Siam**. Indian Forester 54(4), 1928: 249-250; 54(10): 562-563.

A blue book issued by Government of Siam gives a summary of the conditions of the teak forests of Siam and the history of the industry is reviewed.

3949 Bourke, D.R.S. 1927. **The teak industry of Siam**. Government Report, Royal Forest Department.

3950 Briggs, J.L. 1964. **Interim report of the revolutionary government of the Union of Burma on the teak industry (saw-milling and related operations)**. FAO/Expanded Technical Assistance Program Report 692: 41p.

Includes recommendations regarding old saw mills, new saw mills, industrial utilization of saw mill residues, auxiliary equipment, water transport, site of the old Bombay company saw mill at Dalleh and portable saw mills.

3951 Caslam; Dwiprabowow, H. 1994. **The analysis of direct selling performance of teak door products (case study: Teak wood processing industry in Cepu)**. (Indonesian). Jurnal Penelitian Hasil Hutan 12(4): 140-144.

3952 Djaban Tinambunan. 1978. **Manual cross-haul log loading in the teak industry**. Proceedings of the Eighth World Forestry Congress, Jakarta, 16-28 October 1978. Forestry for employment promotion FEP-13-4: 9p.

Results are presented from a study comparing the use of traditional methods of using poles, rope and crowbar and a hand winch system for loading logs onto lorries in central and E. Java.

3953 Gardner, J.R. 1943. **The teak industry of Burma**. Australian Timber Journal 8(2/3): p651, 653, 663, 665, 669, 694-695, 697-698, 714, 716.

3954 Hartono, W. 1979. **Magersaren, a forest village system in teak forest of Java**. Ergonomics in tropical agriculture and forestry: 134-135. PUDOC, Wageningen, Netherlands.

The magersaren forest village consists of twelve houses for forest workers built by the state, the workers are given training in forestry, agriculture and home industries and social facilities, such as education and health services, are provided.

3955 Khovanich, U. 1965. **Administration of teak section of forest industry organization**. (Thai). Vanasarn 23(1): 24-34.

3956 Kittisattho, S. 1993. **Demand for wood and marketing of wood products from wood factory, Changwat Chiang Mai**. Kasetsart University, Bangkok: 101 leaves.

There are only thirty five wood factories could run their business consistently because of raw material shortage and marketing problem of the products. The study found that about 14.29 percent are small wood factories which become to cease their business or to reduce the scale of production. Large wood factories of only about 25.71 percent.

3957 Maydell, H.J von. 1971. **Forest exploitation and forest industries in Ecuador. Forests and forestry in Ecuador**. Holz Zentralblatt 97(127/129): 1845-1846.

Briefly discusses problems of exploitation, plywood manufacture and future prospects in Part 1. Part 2 deals with forest types, species, etc., and development programmes, including projects for afforestation and trial plantings in coastal areas with *Tectona grandis* and other species.

3958 Mekvichai, B. 1988 . **The teak industry in north Thailand: The role of a natural resource based export economy in regional development**. Dissertation Abstracts International A, Humanities and Social Sciences 48(12): p3215.

The regional political economic and ecological effects are examined of over a century of a natural resource-based export economy, the teak industry of northern Thailand. Teak logging has altered the forest vegetative structure, causing changes in age structure and size of teak trees, higher regeneration of teak and higher density of vegetation, but with a reduction in number of species. Higher erosion rates and lower soil nutrient content, and higher runoff and lower water-retaining capacity were found in the soils of the more disturbed teak forest.

3959 Naing, U.K.K. 1997. **Wood based industries (teak) in Myanmar (a brief account)**. TEAKNET Newsletter 7: 6-7.

3960 Oluwalana, S.A. 1997. **An economic assessment of the existing teak and Gmelina plantations in Ogun State, Nigeria.** Nigerian Journal of Forestry 27(1/2): 40-47.

The economic assessment of the plantations shows that huge economic losses are sustained from the poor conversion of the woods in the sawmills. It is suggested that urgent steps are required to reduce wood waste in sawmills.

3961 Prahasto, H; Purnama, B.M. 1994. **Value-added of teak processing industry in Perum Perhutani Unit 1, Central Java**. (Indonesian). Jurnal Penelitian Hasil Hutan 12(1): 30-35.

3962 Radomiljac, A; Anderson, C; Sturre, T. 2003. **Development of a teak plantation industry in north Queensland, Australia**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Establishment success and the early growth provide evidence that plantation of teak has strong potential for commercial success in Australia.

3963 Suryasanoesiputra, H; Sastrodirahardjo, E. 1978. **Development pattern of integrated wood industries Perum Perhutani**. (English; Indonesia). Duta Rimba 4(26): 18-27.

A general account of the state owned forest industry in central and E. Java, which converts an increasing proportion of the teak logs produced by the state forest enterprise. Details are given of the various products and their output capacity at Central Java, which produces lumber, veneer, mouldings and parquet.

Go top

Wood Properties

(See also 2703, 4449, 4664)

3964 **Madagascar teak and Malabar mahogany**. Indian Forester 17, 1891: p447.

Madagascar teak is considered as a poor substitute for Malabar teak in London market.

3965 **Java teak**. Indian Forester 30(12), 1904: 542-543.

A note giving teak wood production figures in Java and export quantities with list of countries.

3966 **Indian teak supreme**. Indian Forester 52(8), 1926: p430.

Reports supremacy of Indian teak in U.K. and other countries for heavy work and forecasts great potentialities of export trade.

3967 **Teak in the Dehra Dun Division**. Indian Forester 52(9), 1926: 474-475.

From Lachiwala teak plantation of 50 years old 4.5-5 ft. girth at b.h. sample fellings revealed sound wood. Tests revealed Dehra Dun teak is slightly stronger than and not so stiff as most other trees of teak tested. Average strength values are above the common values for teak in general including Burma teak.

3968 **Burma teak**. Empire Exhibition, Glassgow, 1938: 28p.

Uses and properties of Burma teak are given.

3969 **Teak: Table of characters and properties of *Tectona grandis* Linn.f**. Holz 2(7/8), 1939: 319-320.

3970 **A craftsman must choose his wood**. Carp. Build. 135, 1946: p226.

Notes on the characteristics and uses of teak are given along with oak, ash, mahogany and birch.

3971 **Teak (*Tectona grandis*)**. Forest Research in India and Burma 1948-49 Part II, 1949: p36.

Based on thinnings in All India Teak Seed origin plots and statistical analysis of data, Nilambur and South Bombay origins are considered best conclusions of experiments with splitting teak stumps.

3972 **Teak (*Tectona grandis*)-colonial timbers**. Bios et Forests des Tropiques 15/16, 1950: 255-260; 361-368.

Teak is one of the species described.

3973 **We have been asked**. Bois et Forests des Tropiques 46, 1956: 48-54.

Dealt with many questions including use of teak thinnings as telegraph poles.

3974 **World timbers 15-18**. Suppls. to Wood 26(11/12), 1961: p27.

Dealt with teak along with many other timbers.

3975 **The properties of tropical woods. 20. Studies on the utilization of nine species from New Guinea and other areas**. (Japanese). Bulletin of the Government Forest Experiment Station, Meguro 269, 1974: 1-95.

Gives detailed descriptions of nine timbers which include teak.

3976 **Properties and uses of timbers from Papua - New Guinea and Fiji**. Timber and Wood Products Manual, Section 1H-4, 1977: 4p.

Information is tabulated giving trade and botanical name, colour, density, strength, shrinkage, durability and treatability and structural and general uses for 31 timbers which include teak from Papua New Guinea and 6 from Fiji.

3977 **Teak: Technical data sheet**. Bois et Forests des Tropiques 224, 1990: 39-47.

Wood properties and uses of teak are outlined. Its colour and grain, physical, mechanical and chemical properties, durability, seasoning, energy properties, sawmilling and uses particularly for boat building and furniture making are dealt with.

3978 Arkwright, P. 1961. **Know your timber 89-91**. Woodworking Industry 18(11/12): p659; 721.

Properties of teak are dealt with along with *Sequoia sempervirens* and *Dipterocarpus* spp.

3979 Berdug, A. 1946. **La teck d'Asie ou *Tectona grandis***. International du Bios 13(105): 72p.

Gives the properties and uses of wood.

3980 Bhat, K.M. 1999. **Is fast grown teak inferior in wood quality? - An appraisal: from plantations of high input management**. Wood News 9(1): 17-20.

The present paper discusses wood property differences to forecast the timber quality of teak grown under high input management. It is reported that phenotypically superior fast growing juvenile trees can produce larger diameter logs with greater yield of heartwood. Fast growing provenances/clones can be selected for teak management without reducing wood density. Faster growth in relatively young forest plantations with fertilizer applications/genetic inputs can be advantageous in terms of heartwood volume per tree and timber strength.

3981 Bhat, K.M. 2003. **Quality concerns of sustainable teak wood chain**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Whether teak maintains superiority in fast growing short rotation plantations is a major concern of the tree growers/investors, policy makers, traders and end-users of teak wood chain. While highlighting the teak wood quality demands of global market, promises from teak wood farming and home garden forestry, as sustainable options are discussed in this paper in the light of recent research findings.

3982 Bhat, K.M; Indira, E.P. 1997. **Effects of faster growth on timber quality of teak**. KFRI Research Report 132: 60p. Kerala Forest Research Institute, Peechi.

To enhance the productivity of teak plantations the choice of management techniques envisaged include genetic selection, wide planting spacement and/or thinning, pruning, fertilizer treatment, irrigation, etc.

3983 Bhat, K.M; Priya, P.B; Ancy Mathew. 2000. **Wood biomechanics of fast grown juvenile teak (*Tectona grandis* Linn.f.)**. Hannschristof Spatz and Thomas Speak, Plant Biomechanics: Proceedings of the 3rd Plant Biomechanics Conference, February - Badenweiler, August 2000: 397-402.

There was no significant difference in longitudinal compressive stress between juvenile and mature wood. The fast grown 5-year old trees from farm plantation had much lower bending stiffness although the values of specific gravity, MOR and MCS did not differ much from the standard teak values. It is the shorter and thinner walled fibres with wider microfibrillar angle that emerge as the main determining factors of the lower stiffness of juvenile wood.

3984 Bhat, K.V. 1991. **Teak - the superior timber**. Evergreen 26: p6.

Properties of teak timber are dealt with.

3985 Bianchi, A.T.J. 1936. **A comparative study of Java, Burmese and Siamese teak**. (Dutch; English). Tectona 29(11/12): 871-873.

3986 Blanford, H.R. 1922. **Teak as an even aged crop**. Indian Forester 48(8): 429-431.

Discusses ideal conditions for growth of best quality teak timber and recommends associating subsidiary species with teak in plantations like *Stephegyne diversifolia*, *Adina cordifolia* and *Lagerstroemia flosregniae* etc. which grow slower than teak, cover up soil and remain as understorey, keeping teak crowns free. Recommends wider initial espacement, along with introduction of subsidiary species.

3987 Blokhuis, G. 1919. **Determination table of the sort of trees which are in the teak wood in Java**. (Indonesian; English). Tectona 12: 539-550.

3988 Bonde. 1899. **Teak in Cochin China**. Empire Forestry Review 38: p534.

3989 Bourdillon, T.F. 1895. **The quality of quickly grown teak wood**. Indian Forester 21: 301-303.

Describes the properties of slow-grown and fast-grown teak timbers and concludes that both are suitable for different purposes.

3990 Brascamp, E.H.B. 1915. **Teak from Nigeria**. (Indonesian; English). Tectona 8: 383-384.

3991 Brascamp, E.H.B. 1915. **The Heidelberg grown teak**. Tectona 8: p712.

3992 Brascamp, E.H.B. 1917. **About teak wood of Java from 1746**. (Indonesian; English). Tectona 10: 421-433.

3993 Brascamp, E.H.B. 1921. **About teakwood in East Java in 1774, in Kolonial Archief No. XIX**. Tectona 14(8): 750-753.

3994 Brush, W.D. 1937. **Foreign woods: Teak**. United States Department of Agriculture, Forest Service, Washington, D.C: 11p.

The wood properties, principal uses, geographic distribution and site requirements of *Tectona grandis* are discussed. Commercial quantities in the natural forest are found only in India, Siam and Java.

3995 Brush, W.D. 1945. **Foreign woods: Teak (*Tectona grandis* Linn.f.)**. United States Forest Service, Washington: 13p.

A general account of teak is given which is a revision of an earlier publication.

3996 Cai-Zemo. 1994. **Wood properties of teak growing in Hainan Island**. (Chinese). Scientia Silvae Sinicae 30(6): 548-555.

3997 Caveye. 1905. **Note on strength of teak from various sources**. Bulletin of Social Forester, Belgium 12: p375.

3998 Chandrasekharan, C. 2003. **Qualities of teak and policy issues**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Teak is now grown in different scales by farmers, agriculturists, agro-foresters and investors of various types - individuals, share holding plantation companies and corporations. For reasonable economic return, teak is to be grown in comparatively good soil and requires good maintenance. The focus of this paper is on policy issues relating to the development of teak as a quality timber.

3999 Chowdhury, K.A. 1951. **West Bengal commercial timbers, their identification, prop-**

erties and uses. Indian Forest Records (n.s.) Wood Anatomy 1(3).

Teak along with 26 most important commercial timbers of West Bengal are dealt with. After some elementary notes on anatomical structure of woods, a dichotomous key for these timbers is given, followed by description of each timber with appendices on uses, main sources of supply and strength data etc.

4000 Chowdhury, K.A; Ghosh, S.S. 1958. **Indian woods-their identification, properties and uses - Vol. I**. Forest Research Institute, Dehra Dun.

Gives description of teak wood under the heads general properties, gross structure, strength, seasoning, natural durability, preservative treatment, working qualities, supply and uses.

4001 Chunwarin, W. 1992. **Properties and utilization of teak**. Proceedings of the Seminar on 50 Anniversary of Hyay-Tak Teak plantation, Bangkok, 5-8 August 1992.

Information on teakwood is reviewed. Structure and properties of teakwood are presented, along with discussions of some pertinent uses of teakwood.

4002 Clarke, S.H. 1938. **The properties of timbers as influenced by growth in tropical climates**. Empire Forestry Journal 17: 247-248.

By means of microstaining reactions, it was shown that the greater crushing strength of tropical woods, as compared to that of temperate zone woods is correlated with a higher degree of lignification in the former. Comparison of degree of lignification was done between unrelated species like ash and teak and also species of the same genus and even different trees of the same species growing under temperate and tropical conditions.

4003 Cordero, L.D.P; Kanninen, M. 2003. **Growth and timber quality of *Tectona grandis* in high input plantations of Costa Rica**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

The paper discusses aboveground biomass and the applicability on stand density management, wood quality of young and advance aged plantations, effects of stand density on wood quality, effects of stand density on growth and yield, preliminary pruning program, pruning intensity and timing, and total and merchantable volume equations.

4004 Corvanich, A. 1967. **Thai-teak**. Forestry Industry Organization: 8p. Ministry of Agriculture, Bangkok.

Discusses general properties of teak wood such as moisture content, ash, silica, specific gravity and weight. Discusses the distribution and requirements of teak with historical background of teak forests in Thailand. The largest teak tree of 930 cm in girth 40 m in height standing in Uttaradit province is illustrated. The management of teak forests was described and outlined the Forestry Industry Organization teak activities such as felling, transport, saw-milling and mechanisation in teak trade.

4005 Dahms, K.G. 1989. **Wood portrait: Teak**. (German). Holz als Roh-und Werkstoff 47(3): 81-85.

A general account of taxonomy, trade names, history of the teak trade, distribution, description of the tree, description of the timber, working properties, uses, substitute timbers and economic prospects is given. The main supplier of teak timber is Burma and only limited quantities are exported from Thailand and Indonesia.

4006 De, R.N. 1955. **Exotics of Assam (Teak)**. Indian Forester 81(7): 406-407.

Gives history of introduction of exotic species including *Tectona grandis* in Assam.

4007 Department of Forest Research, Nigeria. 1965. ***Tectona grandis* (teak)**. Forest Products Research Report, Department of Forest Research, Nigeria FPRL/3: 8p.

4008 Desch, H.E. 1947. **On the Mahoganies and teak woods, the teaks (*Tectona grandis*), Rhodesian teak (*Baikiaea plurijuga*), Philippine teak (*Dipterocarpus* sp.), Borneo teak (*Intsia* spp.) and African teak (*Chlorophora excelsa*) and Walnus etc**. Wood 12(11): 324-325.

Describes the teak and several other false teaks listed above.

4009 Dickinson, F.E. 1949. **Properties and uses of tropical woods-1**. Tropical woods 95: 1-45.

Teak is one of the species described and compared with well known American woods. Properties reported include - mechanical, non-mechanical, physical, seasoning, machining, steam bending, etc.

4010 FAO. 1948. **Report of the FAO mission for Siam**. FAO, Rome: 77.

A country report on teak is given. The growth of teak in Siam and comparative rates and qualities of Burma and Java teak are discussed.

4011 Ferguson, J.H.A. 1938. **Selection of stem quality**. (Dutch; English). Tectona 31: 729-740.

The author is of the opinion that form of stem and branching of the tree are constant and controlled genetically and are not affected by external factors such as site or climate, hence cannot be altered or improved by thinning systems. Bole quality can be improved by seed selection and suggests multiplication of mother tree vegetatively in seed gardens. Budding and grafting of teak is suggested.

4012 Forest Department, Burma. 1947. **Rules for girdling teak in Burma**. Chief Conservator, Forest Department, Burma Rules: 21p.

4013 Foulkes, F. 1914. **Teak in Wynaad: A study. Part I**. Indian Forester 40(5): 173-193.

The physiography and locality factors of Wyanad, Kerala are described, with an account of general and economic conditions effecting teak. The general characteristics and floristics of the growing stock are described. Teak forming 4-7 percentage of the natural crop. The distribution of teak as per stock maps and occurrence of mature teak trees are described.

4014 Freitas, M.C.P.G de. 1973. **Study of exotic timbers in Mozambique (I)**. (Portuguese). Rev. Cienc. Agronomicas 6: 3-28.

Gives details of the anatomical characteristics and physical and mechanical properties of the wood of four exotic species in Mozambique, viz. *Cedrela odorata, Melaleuca leucadendron, Tectona grandis* and *Juniperus sinensis*.

4015 Gamble, J.S. 1922. **A manual of Indian timbers**. Sampson Low Marston and Company Limited, London: 526-535.

A general description of tree, wood characteristics, extraction, regeneration methods, growth rates, physical and mechanical properties of different provenances, exports from Burma and other uses of teak like leaves as a dye and ash content of wood, insect pests and diseases are all generally discussed.

4016 Ghati. 1877. **Vitality of teak**. Indian Forester 3(1): 63-64.

4017 Gua, B.E. 1988. **Observations on timber samples of eighteen research and plantation species**. Forestry Division, Solomon Islands, Forest Research Note 53-21-88: 20p.

Observations are reported on the characteristics of wood samples of 18 species including teak from research trials and plantations in the Solomon Islands. Data regarding age, wood density, insect attack, sapstain, sawing properties, knots and heartwood and sapwood of the samples are provided.

4018 Hardjodarsono, M.S. 1984. **Teak (Indonesia)**. 79p. Gadjah Mada University Press, Yogyakarta.

4019 Haslett, A.N; Young, G.D; Britton, R.A.J. 1991. **Plantation grown tropical timbers. 2. Properties, processing and uses**. Journal of Tropical Forest Science 3(3): 229-237.

Wood properties, timber processing characteristics and potential timber uses of ten major tropical plantation species including teak have been evaluated at the Forest Research Institute, New Zealand. The differences between short-rotation plantation grown an longer rotation forest timbers, and the implications of these differences to the processor and user are highlighted. The major problems associated with plantation grown timbers are identified as reductions in density and decay resistance, lower timber recoveries due to growth stresses, smaller log size and a higher frequency of knots.

4020 Heekeren, M.A. 1917. **Teak wood in the Indian forestry**. (Dutch; English). Tijdschrift voor Economische-Geographi 4: 113-125. Agriculture University, Wageningen.

4021 Hilleanau. 1884. **Rubber v/s teak**. Indian Forester 10: 318-319.

Compares the economics and costs of raising rubber and teak plantations and recommends growing teak, as it is considered more profitable.

4022 Hinchiranant, S. 1963. **Verification comparing green and dry teak**. Vanasarn 21(2): 149-154.

Sixteen methods of verification of green and dry teak timbers are listed but they are not considered adequate and the author recommends to develop a more suitable method in the future.

4023 Hopens. 1907. **On teak**. Baifed Zur Tropenflan Zen 12: 378p.

4024 Howard, A.L. 1951. **A manual of the timbers of the world: Their characteristics and uses**. Macmillan & Company Limited, London.

The general characteristics of wood and its natural distribution are described. The properties of teak wood of its water contact resistance, rust prevention, durability etc. are described. The extraction methods including girdling before felling are described and cost of extraction by elephants is discussed. A general account of physical and mechanical properties and comparison of natural and plantation-grown teak is made.

4025 Immink, D.H. 1923. **Distribution of moisture in a green stem**. (Dutch; English). Tectona 16(7): 499-510, Korte Meded Proefsta Boschw 3: 1-13. Agricultural University, Wageningen.

The distribution of moisture in a transverse section through hardwood of teak is described and no correlation was found between this and width of annual rings in a disc. In view of sap movement against osmotic pressures the assumption that hardwood is not concerned with any physiological processes and observed moisture differences between adjoining zones.

4026 Jangal, M. 1877. **Vitality of teak**. Indian Forester 2(6): 313-314.

4027 Jutte, S.M. 1956. **Is yang teak real teak?** (Dutch; English). Houthandel 8: p356.

4028 Kakkar, S.S. 1970. **Insulating properties of some species of wood**. Indian Forester 96(1): 55-60.

Tectona grandis is one of the species for which the dielectric strength and dielectric constant has been measured along and across the grain.

4029 Karani, P.K. 1970. **On teak (*Tectona grandis*)**. Forest Department, Uganda, Technical Note 163.

4030 Keiding, H. 1973. **Case study, tropical hard woods-teak (*Tectona grandis* Linn.f.)**. Lecture notes FAO/DANIDA Training Course on Forest Tree Improvement, Limuru, Kenya, September-October 1973: 23p.

The need to exploit variation in the species by international provenance trials, progeny testing and clonal seed-orchard work, coupled with improvement programmes by vegetative propagation and controlled pollinations is described and the future action and breeding strategy to be adopted is discussed.

4031 Kirchof, F. 1961. **Investigations on teak**. (German). Holz Zentralblatt 87(10): 127-128.

Discussed the small-scale chemical and strength tests on samples from Java and Siam, its extractives, composition of the ash, tensile strength before and after extraction.

4032 Koegh, R.M. 2003. **The importance of quality of teak plantations**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

It is suggested that supplementary plantations are urgently required to produce renewable hardwoods for economic development, poverty alleviation and to decrease pressure on natural forests. Plantations that employ best management practices can be 20 times more efficient, in terms of production, compared to natural forests. Teak is the most widely cultivated quality hardwood species and has many advantages as a plantation grown species. New approaches taken to overcome the problems encountered in conventional plantations including the innovative consortium support system of TEAK 21 are discussed.

4033 Kulchararin, S. 1964. **Study on some characteristics of teak**. (Thai). Student Thesis. Kasetsart University, Bangkok.

A general and incomplete study on the subject.

4034 Lamb, G.N. 1948. **Foreign woods: Origin, use, properties and nomenclature**. Wood Products 53(7): 24p.

Teak is one of the species dealt with along with Chen-Chen and May-flower.

4035 Limaye, V.D. 1956. **Note on relative properties of teak from Burma and Indian regions**. FAO/TSC-56/27, National Progress Report on Teak: India: 21-27.

4036 Longwood, F.R. 1961. **Puerto Rican woods. Their machining, seasoning and related characteristics**. Agriculture Handbook, United States Department of Agriculture 205: 98p.

Discusses and tabulates results of tests including physical properties, warping, termite resistance etc., for the 56 most important native species plus 4 introduced species including teak with illustrated descriptions of each timber and notes on uses.

4037 Lushington, P.M. 1895. **The quality of quickly grown teak wood**. Indian Forester 21: 223-225.

Plantation grown teak is considered not inferior to natural grown teak timber.

4038 Mascarenhas, A.F; Kendurkar, S.V; Gupta, P.K; Khuspe, S.S; Agarwal, D.C. 1987. **Teak**. Cell and Tissue Culture in Forestry, Case Histories: Gymnosperms, Angiosperms and Palms Vol.3: 300-315: J.M. Bonga; D.J. Durzan, Eds. Martinus Nijhoff, Dordrecht.

4039 McDonald, A. 1946. **Teak aristocrat of the hardwoods**. Southern Lumberman 177(2225): 158-160.

Logging practices were discussed and the preference of teak is due to its hardness and durability. It has less coefficient of expansion, less corrosiveness in contact with iron, presence of essential oils making it durable and easy workability on machine or hand tools.

4040 Meniaud, J. 1930. **Properties of teak in tropical Africa**. National Bois College, Paris: 3p.

4041 Myint Kyu Pe. 2003. **Myanmar teak: Quality and exports**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Myanmar is a supplier of forest products, of which teak from natural forests play a major role. In order to ensure sustainable harvest, Myanmar selection system has been applied. Myanmar is committed to sustainable forest management and better market access, a timber certification committee has been established.

4042 Narayanamurti, D (et al). 1958. **Investigations on a specimen of old wood**. (German). Holz als Roh-und Werkstoff 16(7): 245-247.

The results of examining the structure, physical properties, and chemical composition of teak from a beam 1800 years old, from a Buddhist monastery in Kanheri are presented. The lumen was filled with a gum-like secretion and the extractive content was higher than in fresh teak. Density and compressive strength were higher and water absorption less.

4043 Narayanamurti, D; Purushotham, A. 1943. **Studies on permeability Part I, A preliminary note on the permeability of wood and other materials to air**. Indian Forest Bulletin 120 (n.s.) Utilization: 16p.

Measurement of permeability coefficients for several species of woods including teak, fibre-boards, plywood etc., was determined using an apparatus. The influence of various factors on permeability was discussed.

4044 Negi, S.S. 1996. **Teak (*Tectona grandis*)**. Bishen Singh, Mahendra Pal Singh, Dehra Dun, India: 1-3.

4045 Nisbet, J. 1907. **The chief timber trees of India**. Indian Forester 33(1): 41-48.

The importance and value of teak tree is discussed and teak forests of India are described, including seed germination, fire and exploitation problems.

4046 Nopsuwan, P. 1961. **Form quotient of teak at different site in Huay-Tak teak forest, Ngao, Lampang Province**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Studied the form quotient for teak of different site classes and found that site quality is different to sites in form quotient and there is no significant difference between certain sites.

4047 Okuyama, T; Yamamoto, H; Wahyudi, I; Hadi, Y.S; Bhat, K.M. 2003. **Some crucial wood quality issues of planted teak**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

In the context of promoting timber production in fast growing teak plantations, a study is made to show the variability in the

growth and the relationships between growth rate and selected wood properties, including growth stress in plantations of Indonesia and India. Results show that growth acceleration by silvicultural treatment such as fertilization does not always adversely affect the wood qualities in teak.

4048 Oteng-Amoako, A.A; Gyima-Boadi, N; Apetorgbar, M. 2000. **The properties of the intermediate wood in teak**. Forest Products Research Institute, Ghana. Technical Report.

4049 Polato, R; Laming, P.B; Sierra-Alvarez, R. 2003. **Assessment of some wood characteristics of teak from Brazilian origin**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Chemical composition, fibre length distribution, mechanical and physical properties and natural durability are determined to assess the quality of Brazilian wood. Basic density is also determined. It is assumed that Brazilian teak does not differ from the high quality Asiatic teak and it will be suitable for the same range of end uses.

4050 Quint, M.P.L. 1956. **Service report: Teak in Dahomey**. FAO Teak Sub-Commission, Bangkok FAO/TSC-56/21: 4p. FAO, Rome.

4051 Ramakrishnan, V. 2003. **Why are we obsessed with teak**. Wood News 13(1): 8-13.

4052 Record, S.J; Hess, R.W. 1943. **Timbers of the New World**. Yale University Press, New Haven: 640p.

The timbers are grouped in families and families and the genera are arranged alphabetically. Each family is prefaced by a general account of its chief botanical features, its economic importance and distribution and a summary of its wood characters. Each genus is described in detail with special reference to the most important species including teak.

4053 Richter, H.G; Leithoff, H; Sonntag, U. 2003. **Characterisation and extension of juvenile wood in plantation grown teak (*Tectona grandis* Linn.f.) from Ghana**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

For qualitative and quantitative characterisation of juvenile wood, heartwood of eighteen teak trees from five plantations in Ghana was studied with regard to the radial variations in growth ring width, vessel diameter, microfibril angle, natural durability, density, sorption behaviour, compression and bending strength and modulus of elasticity. The results are compared with those obtained from four 81 to 314 year old trees from natural stands in Myanmar. Significant differences between teakwood from plantations and natural stands were detected.

4054 Sandermann, W; Dietrichs, H.H. 1958. **Accessory substances contributing to the properties of woods**. Results of Paper chromatography in Chemical Abstract 52, 6792b.

The extracts of teak woods from Rangoon, Siam, and Java gave tectoquinone in decreasing amounts in the order given, in line with known termite resistance of these woods.

4055 Sandermann, W; Schlumbom, F. 1962. **The effect of filtered ultra-violet light on wood. I. Photometric and chromatographic investigations on wood**. Holz als Roh-und Werkstoff 20: 245-252.

Wood meals from 10 species including teak were irradiated with light. The effect of such radiation is expressed in terms of a change in absorption coefficient. This change increases with decreasing wavelength of the radiation. The effect for wood thoroughly extracted is roughly independent of the species. The effect for original wood is markedly dependent on species.

4056 Sandermann, W; Simatupang, M.H (et al). 1963. **Investigations on woods containing rubber**. (German; English). Holzforschung 17(6): 161-168.

Out of the wood from 150 selected tree species investigated, eight species including teak revealed the presence of rubber in the xylem. In teak and other three species the rubber content was more than one percent. Rubber was confined to the parenchyma tissue of the xylem and tended to be restricted to the heartwood.

4057 Sanwo, S.K. 1983. **Variation in wood characteristics of plantation grown teak (*Tectona grandis* Linn.f.) in Nigeria**. Ph.D Thesis. University Wales, Bangalore.

4058 Savard, J; Andre, A.M; Caumartin, L. 1963. **The action of wood on iron**. (French; English; Spanish). Bois et Forests des Tropiques 91: 41-52.

Describes a rapid method of classifying species as regards their corrosive effects on iron. No action on iron was observed in teak. The method described takes account both of the amount of Fe-ions absorbed by the wood, and the amount of Fe combined with certain extractives which precipitate in the presence of the metalion.

4059 Schwab, E. 1992. **Rate of moisture uptake in wood**. Holz als Roh-und Werkstoff 50(7/8): p312.

4060 Seaman, I.N. 1930. **Plantation grown teak**. Indian Forester 56(10): 421-425.

The relative strength of plantation and natural grown teak is discussed and found that the plantation grown teak is as strong as forest grown material.

4061 Sekhar, A.C. 1966. **A method of evaluation of wood quality on the basis of utilization characters**. Indian Forester 92(4): 269-274.

An index based on adjusted and weighted data for dimensional stability, durability, strength, fissile qualities, wearing qualities, working qualities and appearance is proposed and discussed methods of determining these.

4062 Slade, H. 1895. **Notes on girdling of teak in Tharrawaddy**. Indian Forester 21(3): 104-111.

Notes on locality factors and forests of Tharrawaddy Division are given, along with season and rules of girdling, the methods and problems are described.

4063 Sreefuree, T.S. 1965. **Synthetic teak**. Vanasarn 23(3): 182-184.

The author describes the problem of mixing non-teak and false teak woods in export teak trade, thus lowering quality of teak and its reputation.

4064 Street, E.C.F. 1914. **Substitutes for teak**. Indian Forester 40(7): 381-382.

Reporting the properties of teak like non-corrosive and greasy properties making it durable.

4065 Suvarnasudhi, K. 1950. **Some commercial timbers of Thailand**. Royal Forest Department, Bangkok: 51p.

4066 Suvarnasudhi, K. 1954 . **Some commercial timbers of Thailand: Their properties and uses**. II Edition, Udom Press, Bangkok, Thailand.

The author presents some general information concerning useful timbers of Thailand which contains about thirty two species along with teak.

4067 Temu, A.B; Malende, Y.H. 1988. **Quality assessment of *Tectona grandis* growing at Mtibwa, Tanzania**. Journal of the Tanzania Association of Foresters 6: 11-21.

Visual estimates were made of stem straightness, roundness and decay in teak planted as part of the Mtibwa forest Project. It is suggested that selective thinning would yield a high quality final crop. It is suggested that wounds inflicted during preparation of the planting stock and during the first tending served as entrances for decay fungi.

4068 Timber Development Association, London. 1941. **Teak (*Tectona grandis*)**. Timber Development Association, London: 9p.

This mimeographed pamphlet gives the names, teak substitutes, distribution, characteristics, wood properties and qualities, along with principal uses and sizes of teak timbers ordinarily available in market.

4069 Tint, S; Kyi, W; Kwye, T. 1995. **Properties of teak**. Proceedings of the Teak Symposium Myanmar Japan Technical Co-operation Programme: 4-10.

4070 Topp, T. 1957. **Teak wood and creamery churns of teak**. Maelkeritidende 70(26): 535-537.

4071 Trotter, H. 1941. **The common commercial timbers of India and their uses**. Manager of Publications, Delhi: 234p.

The manual consists of information of timbers and the timbers are listed in groups under the particular uses for which they are suitable. Appended the comparative strength properties of the timbers in percentage of those of teak and an index to botanical and common names.

4072 Troup, R.S. 1932. **Exotic trees from the British Empire**. Clarendon Press, Oxford: 225-227.

Introduction of teak in Queensland, Kenya, Malaya, Nigeria, Nyassaland, Trinidad and Tobago etc., are discussed.

4073 Wagenfuhr, R. 1969. **Wood properties table 12: Teak**. (German). Holztechnologie 10(3): 203-204.

4074 Weaver, P.L. 1993. ***Tectona grandis* Linn.f. teak**. United States Department of Agriculture, Forest Service, SOITF-SM-64: 18p.

4075 Wolff von Wulfing, H.E. 1928. ***Tectona grandis* Linn.f**. Tectona 21: 879-886.

Go top

Wood Structure and Properties

(See also 0667)

4076 **Structure of imported woods (Nos. 26-30)**. (Japanese). Bulletin of Forestry Experiment Station, Meguro, Tokyo 150, 1963: 123-132.

Notes on the anatomy, with low-magnification photomicrographs of transverse, radial and tangential sections of teak are given along with other trees.

4077 Abbate, M.L.E. 1977. **Anatomical, physical and working properties of twenty two woody species from Thailand**. (Italian). Contributi Scientifico Pratici per una Migliore Conoscenza ed Utilizzazione del Legno 21(54): 75p.

The woods of twenty two species from Thailand are briefly described and illustrated with photomicrographs. Comparative tables giving data on the anatomical and physical characteristics of the woods are included.

4078 Akachuka, A.E; Abolarin, D.A.O. 1989. **Variations in pith eccentricity and ring width in teak (*Tectona grandis* Linn.f.)**. Trees: Structure and Function 3(2): 111-116.

Values of percentage of pith eccentricity of stem cross-sections were computed using appropriate geometrical methods and the growth rings of the cross-sections were identified and their widths measured. Pith eccentricity and ring width varied along trees and tree stems. On average, pith eccentricity was highest at the base and top of the merchantable stem. A decrease in ring width corresponded with an increase in the age of the vascular cambium.

4079 Arce, V.H. 2001. **Sapwood heartwood relationships and wood physical characteristics of 10 year old teak from two different plantation densities in Playa Garza, Cuanacasts**. Bachelor Thesis: 36p. Universidad Nacional, Heredia, Costa Rica.

4080 Bailleres, H; Durand, P.Y. 2000. **Non-destructive techniques for wood quality assessment of plantation grown teak**. Bois et Forests des Tropiques 263: 17-29.

Examined whether wood quality is similar when it comes from natural forests and plantations. Need for assessing wood quality of plantation-grown teak led CIRAD-Foret to develop its own methodology and non-destructive assessment techniques on standing trees, which are presented.

4081 Bhat, K.M. 1995. **A note on heartwood proportion and wood density of 8-year-old teak**. Indian Forester 121(6): 514-517.

Wood properties, viz. ring width, basic density and heartwood percentage, were studied at breast height in trees sampled from plantation in Nilambur, Kerala. Faster growth was associated with a higher heartwood percentage while wood density was independent of growth rate.

4082 Bhat, K.M. 1998. **Properties of fast-grown teak wood: Impact on end-user's requirements**. Journal of Tropical Forest Products 4(1): 1-10.

This paper examines selected wood properties of fast-grown teak to assess the impact on end-user's requirements. The juvenile wood is not so weak as to affect the solid wood uses of fast-grown timber from plantations of shorter rotations. Fast-grown wood displays lower microfibrillar angle as well as greater dimensional stability and structural performance.

4083 Bhat, K.M. 1999. **Is fast grown teak inferior in wood quality - an appraisal of wood figure (colour, grain, texture) from plantations of high input management**. Wood News 9(3): 48-49.

The paper discusses wood figures of colour, grain, texture differences and forecasts the timber quality of teak grown under high input management.

4084 Bhat, K.M. 1999. **Is fast grown teak inferior in wood quality? - an appraisal: From plantations of low input management**. Wood News 8(4): 27-31.

The present paper appraises teak wood quality, in terms of heartwood proportion and timber strength, from plantations of relatively low input management in India. Fast growing dominant superior trees yielded higher heartwood percentage per tree during the juvenile period up to 21 years. It is reported that teak has the potential to produce timber of optimum strength in relatively short rotations of 21 years in suitable plantation sites.

4085 Bhat, K.M. 1999. **Properties and utilisation of small timber resource of teak plantations**. The Proceedings of National Seminar on Processing and Utilisation of Plantation Timbers and Bamboo, IPIRTI, Bangalore, 23-24 July 1998: 255-261. K. Damodaran; B.S. Aswathanarayana; T.R.N. Prasad; K. Shyamasundar; S. Padmanabhan, Eds. Indian Plywood Industries Research and Training Institute, Bangalore.

The paper discusses selected wood properties of 13 and 21 year old trees to assess the utilization potential of small timber available from teak thinnings and short rotation plantations in Kerala. It is not so inferior as to be rejected for the manufacture of high value products such as veneer, joinery, furniture, etc. But it requires improved processing technology and revision of grading rules and quality standards for teak plantations and intensive management techniques to enhance the log size and quality and reduce the negative effects of juvenile wood.

4086 Bhat, K.M. 2000. **Investigations into heartwood formation in intensively managed teak plantations**. KFRI Research Report 181: 13p. Kerala Forest Research Institute, Peechi.

A study is made to generate information to see whether fast growth will help in quicker formation of heartwood and whether intensive management practices and site conditions influence the yield of heartwood in short rotation plantations. The preliminary results indicated that heartwood formation begins at the age of even before three years in fast grown trees of managed plantations.

4087 Bhat, K.M. 2000. **Is fast grown teak inferior in wood quality? - an appraisal of durability of juvenile wood**. Wood News 10(1): 37-39.

Appraised the natural durability of 5-year-old juvenile teak grown in a farm plantation in Kerala. The results indicate that the juvenile wood grown in intensively managed plantations is not necessarily inferior in natural durability to that grown in traditional forest plantations. It is comparable in natural durability to the inner heartwood of mature teak.

4088 Bhat, K.M . 2000. **Timber quality of teak from managed tropical plantations with special reference to Indian plantations**. Bois et Forests des Tropiques 263: 6-16.

Fast growing dominant trees found to yield a higher percentage of heartwood per tree during the juvenile period of 21 years. Teak produce timber of optimum strength with relatively short rotations of 21 years at suitable plantation sites.

4089 Bhat, K.M; Bhat, K.V; Dhamodaran, T.K. 1985. **Wood and bark properties of branches of selected tree species growing in Kerala**. KFRI Research Report 29: 34p. Kerala Forest Research Institute, Peechi.

Data are reported on wood and bark density, percentage of bark and heartwood, proportions of anatomical components like fibres, vessels, rays, parenchyma, and fibre length in stems and branches of teak along with ten other species.

4090 Bhat, K.M; Bhat, K.V; Dhamodaran, T.K. 1986. **Thickness and percentage of bark in some timbers grown in Kerala**. Journal of the Indian Academy of Wood Science 17(1): 23-29.

Data are given for nine species including teak.

4091 Bhat, K.M; Bhat, K.V; Dhamodaran, T.K. 1989. **Radial patterns of density variation in eleven tropical Indian hardwoods**. Holzforschung 43(1): 45-48.

Samples from different stump height were analysed for density in teak along with other hardwoods. The radial pattern of density variation differed between species and within species between trees at similar height and within single trees between heights.

4092 Bhat, K.M; Bhat, K.V; Dhamodaran, T.K. 1989. **Fibre length variation in stem and branches of eleven tropical hardwoods**. IAWA Bulletin 10(1): 63-70.

Fibre length variation of stem and branches of eleven tropical hardwoods including teak is studied. It is found that the branch fibres are significantly shorter than stem fibres. In branches, fibre length increased more or less linearly from the pith to the bark, which indicates juvenile growth.

4093 Bhat, K.M; Priya, P.B; Rugmini, P. 2001. **Characterisation of juvenile wood in teak**. Wood Science and Technology 34(6): 517-532.

Properties of juvenile wood were studied of teak from three 63-year-old plantations in Kerala to assess the utilization potential of short rotation timber. Juvenile wood is characterized by wide rings, short fibres, small vessel diameter, low vessel percentage, high percentage cell wall, wide microfibrillar angle and relatively low or almost similar mechanical properties.

4094 Bhat, K.M; Thulasidas, P.K; Easa, P.S. 1989. **Bark fibre length of some Indian tropical trees**. Indian Forester 115(11): 839-841.

Data are reported on the minimum, mean and maximum bark fibre length of thirty Indian timbers including teak from forests in Kerala. Bark fibre length is found generally greater than wood fibre length.

4095 Bhattacharya, J; Chakravarty, K.N. 1976. **On some features of sawdust characters in wood identification**. Journal of the Indian Academy of Forensic Science 15(2): 17-19.

Sawdust of *Tectona grandis* and other tree species was macerated in a mixture of 1g K chlorate and 50 ml concentrated nitric acid, then warmed in a water bath at 50-60 deg C for 1-2 min, rinsed in water, stained with safranin, mounted in glycerol and examined under the light microscope for wood identification.

4096 Brennan, G.K; Radomiljac, A.M. 1998. **Preliminary observations on the utilisation and wood properties of plantation teak (*Tectona grandis*) and African mahogany (*Khaya senegalensis*) grown near Kununurra, Western Australia**. Australian Forestry 61(2): 120-126.

The wood properties and wood quality were assessed of teak grown in irrigated plantations in northern Western Australia. Basic wood properties as well as recoveries, sawing and drying behaviour and working properties were assessed. The plantation teak was golden brown in colour with dark markings.

4097 Carreras, R; Dechamps, R; Avella, T. 1989. **Three-dimensional structure of the wood of five species of Verbenaceae represented in Cuba**. (Spanish). Revista Forestal Baracoa 19(2): 67-84.

Details are given of scanning electron microscopic studies on the anatomical structure of the wood of *Tectona grandis* along with other species.

4098 Chowdhury, K.A. 1939. **The formation of growth rings in Indian trees Part I (a) Chir, (b) Cutch, (c) Jaman, (d) Laurel, (e) Sal, (f) Semul, (g) teak**. Indian Forest Records (n.s.) Utilization 2: 39p.

Growth rings are distinct and annual in teak. Foliar development always preceded diameter growth in the main trunk. In teak activity spreads rapidly downwards and cambial activity has been observed simultaneously in twigs and trunk. The effect of temperature, rainfall and humidity is also discussed.

4099 Chowdhury, K.A. 1940. **The formation of growth rings in Indian trees. Part III. A study of the effect of locality**. Indian Forest Records (n.s.) Utilization 2: 59-75.

Investigations were carried out on the growth activity and dormancy of teak in relation to local climatic conditions. There is a possibility that leaf-fall may be regulated by an internal water balance of the tree. The ring porous wood of teak shows some structural variations in the pore zone according to the locality in which it is grown.

4100 Chowdhury, K.A. 1943. **How to identify timbers. Part III. Timbers for motor lorry bodies**. Indian Forest Leaflet (Utilization) 37: 17-29.

This gives brief anatomical descriptions and a key for the field identification of important Indian timbers including teak used for motor-lorry bodies.

4101 Chowdhury, K.A; Preston, R.D; White, R.K. 1967. **Structural changes in some ancient Indian timbers**. Proceedings of Royal Society of London 168B(1011): 148-157.

Specimen timbers of 2200 years old *Tectona grandis* were examined and compared with wood of the same species along with many other species. It was held in a frequently damp, humid atmosphere for 2200 years is superficially sound, the wood is in part degenerated, the cellulose content, including the crystalline component was considerably reduced.

4102 Clarke, W. 1946. **Photography by infrared; its principles and applications**. John Wiley and Sons, Newyork: 472p. Chapman & Hall Limited, London.

Gives transparency to infra-red rays for teak and other timbers.

4103 Cordero, L.D.P; Kanninen, M. 2003. **Heartwood, sapwood and bark content and wood dry density of young and mature teak (*Tec-***

***tona grandis*) trees grown in Costa Rica**. Silva Fennica 37(1): 45-54.

4104 Coster, C. 1926. **Abnormal structure in stems of *Tectona grandis***. Annales du Jardin Botanique de Buitenzorg: p120.

4105 Das, D.K. 1984. **Wood anatomy of some timbers of Verbenaceae of Bangladesh**. Forest Research Institute Chittagong, Bulletin, Wood Anatomy Series 6: 28p.

Gross features and microscopic anatomy of the wood are described for nine species which include teak. An anatomical key for identification and brief data on distribution in Bangladesh are included.

4106 Dave, Y.S; Rao, K.S. 1982. **Plastid ultrastructure in the cambium of teak (*Tectona grandis* Linn.f.)**. Annals of Botany 49(3): 425-427.

4107 Donaldson, L.A. 1984. **Wood anatomy of five exotic hardwoods grown in Western Samoa**. New Zealand Journal of Forestry Science 14(3): 305-318.

4108 Fernandes, A; Wisnu, J; Hartoyo, A.T; Rulianti, E; Marsoem, S.N; Lukmandaru, G. 2002. **Fiber dimensions of tension wood and opposite wood of teakwood (*Tectona grandis*)**. IAWA Journal 23(4): p462 .

4109 Gogate, M.G. 1995. **Evaluation of growth response of teak to high inputs**. Indian Forester 121(6): 578-580.

Data are reported on the wood properties of sample billets from thinnings from a 7-yr-old irrigated and fertilized plantation in W. Maharashtra. The properties of the thinnings from the irrigated fertilized plantation were found inferior to the standard one and the suitability indices are found 31-80.

4110 Gottwald, H; Parameswaran, N. 1980. **Anatomy of wood and bark of Tectona (Verbenaceae) in relation to taxonomy**. Botanische Jahrbucher fur Systematik, Pflanzengeschichte und Pflanzengeographie 101(3): 363-384.

Wood and bark samples of *T. grandis* were studied under the light microscope and SEM. X-ray microanalysis was used to locate silica and calcium phosphate within the tissues. Both were detected in the vessel lumina of *T. grandis*.

4111 Gupta, R.S. 1950. **A note on the practical application of the recommendations made in the Indian Forest Bulletin No. 141, regarding the forecasting of the quality of teak from the soil and site characteristics**. Indian Forester 76(5): 210-214.

The field laboratory methods are given for determining ratio of SiO_2 to sesquioxides, dispersion coefficient and depth of permanent moisture availability together with a list of necessary apparatus and chemicals.

4112 Hamza, K.F.S; Ringo, W.N. 1991. **Variation of heartwood proportion in plantation grown *Tectona grandis* Linn.f**. Faculty of Forestry, Sokoine University of Agriculture, Record 51. Morogoro, Tanzania.

The age at which heartwood starts to form and the relation between various stem parameters and heartwood proportion in *Tectona grandis* were studied in plantations in Tanzania. Determined the heartwood proportion and its variation with age, diameter at breast height, total tree height and height in the stem. It was found that heartwood starts to form when the trees are between 7 to 9 years old.

4113 Hillis, W.E. 1968. **Heartwood formation and its influence on utilization**. Wood Science and Technology 2(4): 260-267.

The chemistry and biochemistry of teak wood is provided.

4114 Isenberg, I.H. 1952. **Fiber measurements of tropical wood fibers**. Tappi 35(4): 145-147.

Gives dimensions of fibres and vessel segments for twelve species of tropical American hardwoods and Burma teak.

4115 Jane, F.W. 1956. **The structure of wood**. Adam and Charles Black Limited, London: 427p.

The names and classification of timbers with a classified list of more important plant genera that produce wood of economic importance, the histology of wood, the trunk of the living tree, the gross structure of wood, the histology of deciduous woods, etc. are provided. A key for the identification of wood and specific differences in timbers, with an appendix on technique for wood anatomy is also provided.

4116 Johnston, D.R. 1951. ***Pseudotsuga taxifolia, Mimusops havhalli, Pterocarpus dalbergloides, Tectona grandis* structure drawing to specimen woods-Sheet 2**. Wood 16(8): p304.

A general series of structural drawings relating to gross features with descriptions of woods, in which teak is also included.

4117 Kadambi, K. 1956. **On the nature of twisted fibre and the occurrence of interlocked fibre in some trees**. Proceedings of the 8th Silvicultural Conference, Dehra Dun, 1951, Part 2: 227-228.

Species are listed in which spiral grain, interlocked grain, or both, have been found. The list include teak also. Interlocking grain improves bending and shear strength.

4118 Kawcharoen, K. 1962. **Percentage of barkwood of teak at Mae-Huat Forest, Lampang**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Analysed twenty teak trees in diameter classes 35-55 cm and height classes 25-30 m and 34-35 m.

4119 Kedharnath, S; Chacko, V.J; Gupta, S.K; Mathews, J.D. 1963. **Geographic and individual tree variation in some wood characters of teak (*Tectona grandis* Linn. f.). I. Fibre length**. Silvae Genetica 12(6): 181-187.

Variations in fibre length were measured of trees of four seed origins of Nilambur, N. Bombay, N. Burma and S. Burma. It is found that fibres in the ring nearest the pith were very short, but their length increased rapidly in the next few rings and thereafter slowly. Differences varied according to provenances.

4120 Kokutse, A.D; Bailleres, H; Stokes, A; Kokou, K. 2004. **Proportion and quality of heartwood in Togolese teak (*Tectona grandis* Linn.f.)**. Forest Ecology and Management 189(1/3): 37-48.

The heartwood proportion, modulus of elasticity and wood density of trees of various ages from different ecological zones in Togo were examined to determine the ecological zone which produce the best quality teak wood.

4121 Lawton, J.R. 1971. **Seasonal variations in the secondary phloem of some forest trees for Nigeria**. New Phytologia 70(1): 187-196.

Samples of bark were taken from the main trunk of trees including teak and found the amount of active phloem and the total depth of the fluorescent zone. The greatest amount of active phloem coincided with the rainy season.

4122 Mathew, L; Shah, G.L. 1983. **Vestured pits and warts in Verbenaceae**. IAWA Bulletin 4(1): 39-40.

Of the twenty three species studied warts were observed on the inner surface of vessels in *Citharexylum* and *Tectona grandis*.

4123 Menon, P.K.B. 1947. **Growth rings of locally-grown teak**. Malaysian Forester 11(1): 26-27.

Teak poles analysed had diamond-shaped piths with elongated comers. The larger poles had dark-coloured heartwood of irregular shape. The growth rings varied in width. They were fairly distinct although not so clear as in teak grown in regions with definite seasons. The rings were usually caused by regions of denser fibres, strands of bright-coloured parenchyma and larger-sized vessels.

4124 Moya, R. 2002. **Effect of cambium age, growth rate and precipitation on the basic density of teak in Costa Rica**. (Spanish). Madera y Bosques 8(1): 39-49.

A study is made to determine the change in specific gravity in the radial direction, from the pith to the bark, as well as the influence of cambium age, growth rate and precipitation in trees growing at the Caribbean side of the Costa Rica. Results showed that specific gravity increases from pith to bark and that it is affected by cambium age and growth rate.

4125 Nair, M.N.B; Chavan, R.R. 1985. **Dimensional analysis of some wood parameters in eleven timber trees**. Indian Forester 111(6): 410-417.

Relationships of trunk length, girth, cross-sectional areas of wood, heartwood and sapwood, heartwood/sapwood ratio and percentage of heartwood in the cross-section were studied for eleven timber species including *Tectona grandis* and the results are presented.

4126 Narayanamurti, D; Prasad, B.N. 1959. **Examination of Indian woods by x-rays**. Holz als Roh-und Werkstoff 17: 223-226.

X-ray diffraction was used to determine micellar orientation and it was found in teak. It has irregular orientation.

4127 Nobuchi, T; Boonplian, S. 1992. **Some characteristics of teak (*Tectona grandis* Linn.f.) wood in relation to wood quality**. IAWA Bulletin 13(3): p260.

Samples were analysed for seasonal characteristics of wood formation and heartwood formation.

4128 Parameswaran, N. 1964. **The length of septate fibres in *Tectona grandis***. (German). Report from Naturwissenschaften 51(13): 317-318.

Fibre length in both septate and non-septate fibres in two successive growth rings of a stem with ring-porous wood increased from the early to the late wood. Septate fibres were shorter than non septate fibres and their increase in length in the late wood was less. Mean fibre length increased significantly from pith to bark.

4129 Priya, P.B; Bhat, K.M. 1997. **Wood anatomical changes in juvenile teak due to insect defoliation**. IAWA Journal 18(3): 311-317.

Selected anatomical characteristics and wood specific gravity of 8-year-old teak trees growing in Nilambur protected from insect defoliation were compared with those from an unprotected population. During the protection period of four years trees showed a considerable increase in growth rate relative to unprotected trees.

4130 Pumijumnong, N; Eckstein, D; Sass, U. 1995. **Tree-ring research on *Tectona grandis* in Northern Thailand**. IAWA Journal 16(4): 385-392.

The first principle component of the data showed 44 percent of the total variation in the tree-ring data, indicating a considerable climate influence on tree growth. The climate/growth relationship suggested that growth of the teak in the study area is mainly controlled by rainfall from April to June.

4131 Purkayastha, S.K; Rao, K.R. 1969. **Studies on the relationship between structure and specific gravity in teak**. Recent Advances in the Anatomy of Seed Plants. Choudhury, K.A., Ed: 127-35. Hindustan Publishing Corporation, Delhi.

4132 Purkayastha, S.K; Tandon, R.D; Rao, K.R. 1972. **Variation in anatomical structure of teak and its influence on specific gravity and maximum crushing stress**. Indian Forester 98(6): 332-337.

Studies on samples of teak in India showed that fibre-wall thickness was significantly correlated with the specific gravity of the wood, and that this relation was influenced to some extent by the proportion of fibres in the wood. There was also a highly significant correlation between fibre-wall thickness and maximum crushing stress.

4133 Rao, C.J.M; Reghu, C.P; Patel, J.D. 1982. **Rays in reaction wood of three angiosperm species**. Indian Journal of Forestry 5(3): 216-222.

Vertical branches and inclined branches of identical girth and inclination were selected from trees including *Tectona grandis* from the University Botanical Garden at V.V. Nagar. The lower tiltwood of *T. grandis* had more rays than the higher tiltwood. Rays contiguous to vessels were taller than those contiguous to fibres and axial parenchyma.

4134 Rao, K.R; Purkayastha, S.K; Tandon, R.D. 1966. **Effect of rate of growth on proportion of tissues in teak**. Indian Forester 92(2): 133-136.

Preliminary studies of the proportion of tissue elements in several consecutive growth rings, using Ladell's method in two samples of *Tectona grandis* from Mysore and Kerala showed no definite relationship between ring width and the proportion of tissues, but differed in their tissue elements.

4135 Rao, K.S. 1988. **Cambial activity and developmental changes in ray initials of some tropical trees**. German Democratic Republic Flora 181(5/6): 425-434.

Structure, divisional activity and dimensional variations of ray initials in *Tectona grandis*, *Gmelina arborea* and *Mangifera indica* were studied in relation to the annual cycle of cambial activity.

4136 Rao, K.S; Dave, Y.S. 1983. **Ultrastructure of active and dormant cambial cells in teak (*Tectona grandis* Linn.f.)**. New Phytologist 93(3): 447-456.

4137 Sanwo, S.K. 1987. **The characteristics of the crown-formed and stem-formed wood in plantation grown teak (*Tectona grandis* Linn.f.) in Nigeria**. Journal of the Institute of Wood Science 11(2): 85-88.

Samples were taken from different locations within the crown formed wood ie. between the first and seventh ring from the pith and stem formed wood ie., rings eight outwards from Ibadan. The samples were assessed for ring width, relative density, MOR, MOE, total work done and maximum compressive strength parallel to the grain. The crown formed wood had statistically higher values for ring width, relative density and maximum compressive strength than the stem-formed wood.

4138 Srisakdi, P. 1962. **Stem analysis of teak**. (Thai). Student Thesis. Kasetsart University, Bangkok.

On the basis of data of twenty teak trees in dbh class 30-68 cm and heights 2.4 to 34.8 m, it was found out rate of growth in height, volume and dbh for age classes 10, 20, 30, 40 and 80 on upto 130 years.

4139 Starte, H.W. 1923. **Peculiarity noticed in the annual rings of teak Kolaba Division, Bombay**. Indian Forester 49(7): 392-393.

Growth rings on teak towards later part of life of tree are so close and dense as undistinguishable, except, outer 2 or 3 rings. Outer sapwood appeared as a mass of spongy tissue.

4140 Sukwong, S. 1971. **Estimating the age for trees without annual rings**. (Thai). Faculty of Forestry, Kasetsart University, Thailand, Research Note 5: 4 p.

A method for determining the age of trees by calculations based on the growth percent, was checked against one plot of teak of known age in a plantation at Lampang. Results showed the calculated age to be close to the actual age.

4141 Sutopo, S. 1992. **The enhancement of utilization quality of young teak wood for furniture crafting in Surakarta**. Duta Rimba 18(147/148): 2-6 (In), 7-10 (En).

An investigation was made of the utilization of teak thinnings for furniture making in Surakarta Forest District, Java. The traditional finishing processes are described and finishing problems of blistering, bubbling, cracking etc. caused by use of wood with too much moisture content noted.

4142 Tativa, G.E; Sadhardjo; Corryanti. 2002. **Wood anatomy of teak**. The Fifth Pacific Regional Wood Anatomy Conference. Abstracts from the Meeting of the IAWA Pacific Regional Group and IUFRO S 5.01 (Wood Quality), Yogyakarta, Indonesia, 9-14 September 2002. IAWA Journal 23(4): P480.

4143 Varghese, M; Nicodemus, A; Ramteke, P.K; Anbazhagi, G; Bennet, S.S.R; Subramanian, K. 2000. **Variation in growth and wood traits among nine populations of teak in Peninsular India**. Silvae Genetica 49(4/5): 201-205.

Growth, wood characteristics and bark thickness were studied in relation to climatic, edaphic and latitudinal factors in 60-year-old plantations and natural populations of teak. The very moist population of Nilambur, Kerala is found to have the best growth and form but comparatively lower wood density on par with the slightly moist natural stand and the dry teak population of Maharashtra. Sapwood content was negatively correlated with growth rate. Properties of bark thickness and wood density are also investigated.

4144 Venugopal, N; Krishnamurthy, K.V. 1987. **Seasonal production of secondary phloem in the twigs of certain tropical timber trees**. Annals of Botany 60(1): 61-67.

Results of a study based on samples from four deciduous trees including teak and three evergreen trees in Tamil Nadu are presented. There was one flush of phloem production in *Tectona grandis* and the evergreen species and there were two flushes in the other deciduous species.

4145 Venugopal, N; Krishnamurthy, K.V. 1987. **Seasonal production of secondary xylem in the twigs of certain tropical trees**. IAWA Bulletin 8(1): 31-40.

Results of the study based on samples of four deciduous species including teak and three evergreen species from Tamil Nadu are presented. The phenology and secondary xylem production of each species are briefly described. In the evergreen species and *Tectona grandis*, there was only one annual period of xylem production.

4146 Venugopal, N; Krishnamurthy, K.V. 1989. **Organisation of vascular cambium during different seasons in some tropical timber trees**. Nordic Journal of Botany 8(6): 631-638.

The vascular cambium of *Tectona grandis* was non-storied. Ray initials were multiseriate. The radial walls of cambial cells were beaded. The fusiform initials were less vacuolated during dormancy.

4147 Wang, S.Y. 1988. **The properties and identification of S.E. Asian woods (X)**. (Chinese). Forest Products Industries 7(2): 79-90.

Descriptions of teak are given along with other species.

Go top

Go top

Physical and Mechanical Properties

(See also 0860, 4316)

4148 **Strength of plantation and natural grown teak in South India**. Indian Forester 38(3), 1912: 126-128.

Results of compression tests, shearing tests and transverse strength of natural and plantation timber are tabulated. The tests show plantation teak is slightly stronger than natural teak plantation.

4149 **Colonial timbers**. (French). Bois For. Trop 15-6, 1950: 251-260.

Dealt with teak along with other timbers.

4150 **Physical and physico chemical investigations**. Forest Research in India Part I: 1951-52, 1952: p66.

The influence of psychrometric conditions on the properties of six species including *Tectona grandis* was investigated. Generally the strength values were higher for the laminated material than for the solid wood. The strength in bending and compression decreased with increase in moisture content.

4151 **Quality of locally-grown teak**. Malaysian Forester 17(1), 1954: 29-30 .

Notes on physical and mechanical properties of wood from one 30 year old tree grown in Johore. They compared favourably with those for teak from Burma and Malabar.

4152 **Dielectric properties of some Indian species**. Forest Research India and Burma 1950-51 Part 1, 1955: 73p.

Preliminary experiments were made on the dielectric breakdown strength of various species including teak.

4153 **Gluing teak**. (Norwegian). Extract from Arsberetn Norsk Tretekn. Inst 21, 1963: p37.

The efficiency of the following glues have been studied and found that furfuryl modified urea glue, an acid phenolic glue, and a 1:3 mixture of PVA and urea glues gave excellent results. Ordinary urea and PVA glues gave good results with pressures and resorcinol. Cleaning the surface with non-polar solvents before applying urea, or sanding the surface before gluing with PVA or casein glues, appeared to improve results.

4154 Ashiabor, W.K. 1968. **The properties of *Afzelia africana, Anogeissus liocarpus, Cynometra ananta, Guibourtia ehie* and *Tectona grandis***. Forest Product Research Institute, Ghana, Technical Note 6: 7p.

The results of strength tests on these species, carried out at the Forest Products Research institute, Ghana are tabulated. Brief notes are given on species distribution, wood characteristics and utilization.

4155 Aswathanarayana, B.S; Victor, V.J. 1973. **Stress relaxation in wood**. Journal of the Indian Academy of Wood Science 4(1): 1-12.

Some theoretical aspects of stress relaxation are considered from the molecular point of view, and stress-relaxation tests in compression parallel on samples of *Tectona grandis* are described. The effects of initial stress value and moisture content on stress decay were investigated.

4156 Bali, B.I; Gupta, V.K. 1980. **A note on the physical and mechanical properties of *Shorea talura* from eastern Kanara division, Karnataka**. Journal of the Timber Development Association of India 26(2): 8-10.

Physical and mechanical properties are tabulated for green and air-dried *Tectona grandis* along with *Shorea talura*.

4157 Bali, B.I; Guru, R.D; Negi, Y.S. 1987. **A note on the physical and mechanical properties of *Bischofia javanica* (uriam) from Banderdeva Division, Arunachal Pradesh**. Indian Forester 113(4): 287-294.

Comparative data are tabulated for standard teak from Nilambur, Malabar and Coimbatore.

4158 Bali, B.I; Singh, K.R. 1981. **A note on the physical and mechanical properties of *Aphanamixis polystachya* (*Amoora rohituka*) from Kalimpong division, West Bengal**. Journal of the Timber Development Association of India 27(2): 30-35.

Comparative data of standard teak is given.

4159 Bali, B.I; Singh, K.R. 1983. **A note on the physical and mechanical properties of *Tectona grandis* (teak) from Gorakhpur Division, Uttar Pradesh**. Journal of the Timber Development Association of India 29(1): 25-34.

Physical and mechanical properties in green and air dry conditions based upon tests conducted on small clear specimens obtained from three logs of *Tectona grandis* from Gorakhpur Division, Uttar Pradesh have been reported. Suitability indices and safe working stresses have been reported and compared with the corresponding value of standard teak. Calculated values based on strength - specific gravity relationship have also been reported for comparison purpose.

4160 Batey, T.E; Wangaard, F.F. 1949. **Moisture absorption in certain tropical American woods**. Yale School of Forestry, Technical Report 1: 7p.

The results of tests of water absorption of twenty five tropical American species including teak are given and the timbers are classified according to overall absorption of moisture into the heartwood and the side grain absorption of moisture into the middle portion of the heartwood of endcoated specimens.

4161 Berger, L.G den. 1926. **Mechanical properties of Dutch East Indian timbers**. Korte Meded Proefsta Boschw 12: 63p.

Results of bending tests, end-wise compression, shearing cleaving and hardness tests for teak and other species are tabulated. The specific gravity of wood, mechanical properties of green and air dry woods and growth rings are given.

4162 Betancur Salgado, C.A; Herrera, B.J.F; Mejia Mesa, L.C. 2000. **Study of the physical and mechanical properties, workability and drying of teak (*Tectona grandis* Linn.f.) in Puerto Libertador (Cordoba)**. (Spanish). Revista Facultad Nacional de Agronomia Medellin 53(1): 913-939.

The Caribbean Reforest Company established a teak plantation in the region of Puerto Libertador, Colombia. Data were collected on specific gravity, shrinkage and humidity content, static bending, compression parallel and perpendicular to grain, shear parallel to grain, hardness, nail resistance and toughness. The workability test was carried out in air dried conditions, observing the reactions of wood to brushing, moulding and drilling.

4163 Bhat, K.M. 1995. **Properties and quality of teak timber with special reference to juvenile wood**. Amazon Teak Foundation, Consultancy Report: 46-50; Raadhuisstraat, The Netherlandas: 1-39.

4164 Bhat, K.M; Bhat, K.V; Dhamodaran, T.K. 1987. **A note on specific gravity difference between dominant and suppressed trees in teak (*Tectona grandis* Linn.f.)**. Indian Journal of Forestry 10(1): 61-62.

Relative density was estimated for samples taken from two dominant and two suppressed trees from a plantation at Nilambur, Kerala.

4165 Bhat, K.M; Bhat, K.V; Dhamodaran, T.K. 1990. **Bark specific gravity in stem and branches of nine Indian timbers grown in Kerala**. Indian Journal of Forestry 13(1): 26-29.

Data are reported for nine species including teak. Bark specific gravity was reported higher than that of wood in six species including teak. Correlations between wood and bark specific gravity were significant for most species.

4166 Bhat, K.M; Bhat, K.V; Dhamodaran, T.K. 1990. **Wood specific gravity in stem and branches of eleven timbers from Kerala**. Indian Forester 116(7): 541-546.

Basic specific gravity was determined for blocks cut from stems and branches of eleven species from Kerala. Data are tabulated on average specific gravities at base, middle and top of stems and branches, and average of overall specific gravity of stems and branches. Seven timbers including teak were classed as moderately heavy.

4167 Bhatnagar, N.S. 1964. **Creep of wood in tension parallel to grain**. (German). Holz als Roh-und Werkstoff 22(8): 296-299.

Short and long term creep tests on teak showed that creep deformation was a linear function of stress up to a certain limiting stress and a non-linear one above it.

4168 Bianchi, A.T.J. 1937. **The mechanical properties of Java, Siam and Burmese teak**. (Dutch; English). Tectona 30(5/6): 33-49. Nederland-Sch--Indie 60.

Strength data is presented on static bending, impact bending, compression parallel to grain, shear, cleavability and special grade of material and results presented for different samples from different countries. Java material lies between Burma and Siam in its mechanical properties.

4169 Biblis, E.J. 1965. **Shear deflection of wood beams**. Forest Products Journal 15(11): 492-498.

The paper shows the relative contribution of shear deflection to the total deflection of rectangular wood beams of several species including *Tectona grandis*. It demonstrates how the amount of shear deflection is affected by the ratio of pure modulus of elasticity to modulus of rigidity of the species and by the span-to-depth ratio of the beam.

4170 Boye, C. 1965. **A study of some electric moisture meters for wood**. (Danish). Troeindustrien 15(11): 139-146.

Gives tabulated results of a study comparing measurements made with seven moisture meters on different species including teak.

4171 Bryce, J.M. 1966. **Mechanical properties of Tanzania-grown teak (*Tectona grandis* Linn.f.)**. Utilization Section, Forest Division, Moshi, Technical Note 34: 5p.

Tests made on plantation grown teak from near Korogwe showed that it was 15 percent weaker in properties than specimens from Burma and Trinidad. There was a positive correlation between strength and specific gravity, and a negative correlation between density and rate of growth.

4172 Burmester, A. 1972. **Swelling and swelling anisotropy of wood in various moisture content ranges**. (German). Holz als Roh-und Werkstoff 30(10): 380-381.

The relative swelling in the tangential and radial directions is expressed in percent of the maximum swelling. It was found that about half the total swelling takes place between 86 and 100 percent of relative humidities.

4173 Burmester, A. 1975. **Dimensional stabilization of wood**. (German). Holz als Roh-und Werkstoff 33(9): 333-335.

The good dimensional stability of *Tectona grandis* is attributed to its low content of hydrolysable hemicelluloses. By heat/pressure treatment of moist wood similar effects are obtained. On filling the void spaces in the wood structure or on cross-linking between molecules, dimensional stability of wood can be improved.

4174 Burmester, A; Wille, W.E. 1975. **Investigations on the dimensional stability of teak**. Holz als Roh-und Werkstoff 33(4): 147-150.

Physical and chemical investigations were made on material from a freshly felled teak tree and from a tree that had been left standing for two years after girdling the sapwood. It is suggested that the low content of hydrolysable hemicelluloses in teak is an important factor in its dimensional stability.

4175 Castro, F; Raigosa, J. 2000. **Growth and physical mechanical properties of seventeen years old teak (*Tectona grandis*) growing in San Joaquin, Abangares, Costa Rica**. (Spanish). Agronomia Costarricense 24(2): 7-23 [Revista Forestal Centroamericana 35, 2001: 19-24].

The physical and mechanical properties of seventeen year old teak trees growing in San Joaquin, Costa Rica were evaluated according to the ASTM standard. Results of the physical and mechanical properties studied indicate that teak timber from Costa Rica have good dimensional stability.

4176 Coster, C. 1923. **Moisture content and regional spread of moisture in living teak**. (Indonesian; English). Tectona 16(11/12): 935-1045.

Regional spread of moisture in a tree from base to top are examined. Moisture content is expressed as percentage of cell cavity filled with free water as moisture content depends on the special grade of wood.

4177 Coster, C; Immink, D.H. 1930. **Research of the same physical properties of teak wood and both sorts of Mahogany**. Meded Boschbouw Proefsta 18.

4178 Deshkar, A.M; Dara, S.D. 1988. **Sorption of mercury by *Tectona grandis* bark**. Asian Environment 10(4): 3-11.

4179 Dharmcharee, B. 1957. **The active principle in *Tectona grandis***. (Siamese; English). Vanasarn 15(2): 23-31.

Reviews previous work and gives results of the physical and chemical experiments on samples of teak from various parts of Siam. Analysis of the ether extractive yielded o-cresyl-methyl-ether, with the characteristic odour of teak wood, which the author considers is the active preservative principle. Results of some further investigations of this compound are discussed.

4180 Ding, J.Y. 1979. **Studies on dimensional stabilization of woods (1) The stabilization of woods by treatment of stearamidomethylpyridinium chloride**. (Chinese). Experimental Forest, National Taiwan University, Technical Bulletin, 124: 75-102.

This reagent was shown to be more satisfactory than PEG in the treatment of six high-density species including teak.

4181 Doungpet, M. 2003. **Physical and mechanical properties of juvenile teak wood (*Tectona grandis*)**. IUFRO Division 5 conference, Rotorua, 11-15 March 2003.

4182 Durand, P.Y. 1983. **Wood technology research in the Ivory Coast. Towards a rational utilization of secondary species of the natural forest and technological control of quality and quantity of plantation-grown timber**. Bois et Forests des Tropiques 202: 35-52.

The density and shrinkage was assessed of twenty nine secondary species. Some species of potential industrial value could be selected from the initial results. Wood technology studies were made of the plantation species *Tectona grandis* and *Gmelina arborea*.

4183 El Osta, M.L.M; Badran, O.A; Ajoung, E.M.A. 1981. **Crushing strength of three Sudanese tropical hardwoods in relation to specific gravity, extractives and lignin contents**. Wood Science 13(4): 225-232.

Three Sudanese tropical hardwoods studied are *Tectona grandis*, *Khaya grandifoliola* and *Isoberlinia doka*.

4184 Eligon, A; Saunders, R; Kai, A.T; Hutchison, J.D. 1984. **Studies on hysteresis properties in Trinidadian timber**. Proceedings of the Pacific timber engineering conference, Auckland, New Zealand, May 1984. Volume III. Wood science: 840-848. Institution of Professional Engineers, Wellington, New Zealand.

Expansion and contraction properties were studied in six commercially important species including teak exposed to a series of increasing and decreasing Rh environments.

4185 Forest and Forest Products Research Institute, Japan. 1978. **Properties of some Papua New Guinea woods relating with manufacturing processes. VIII. Lumber processing of some West New Britain woods**. (Japanese). Forest and Forest Products Research Institute, Japan, Bulletin 299: 105-149.

Sawing studies on twenty three species including teak showed that heavier woods required more power from the saw. Optimum schedules are presented for kiln seasoning of these species. Cutting properties, gluing properties, curing time and cracking of varnish films, bending strength and nail-holding properties are tabulated.

4186 Forest and Forest Products Research Institute, Japan. 1978. **Properties of some Papua New Guinea woods relating with manufacturing processes. VI. Wood qualities, physical properties and decay durability of some West New Britain woods**. (Japanese). Forest and Forest Products Research Institute, Japan, Bulletin 299: 23-84.

Structure, physical and mechanical properties and resistance to fungal decay were investigated in twenty three species. Log dimensions, interlocked grain, brittle-heart, moisture content, relative density, shrinkage, static and impact bending strength, weight loss caused by decay, and retention of preservatives are tabulated for each species.

4187 Fujita, S; Takahashi, A; Sakurai, T. 1967. **On the drying properties of tropical woods**. (Japanese). Bulletin Faculty of Forestry, Shimane University, Japan 1: 83-86.

Examined the relationship between kiln-drying time and seasoning defects in *Tectona grandis* along with other species and tabulates the drying time required for a reduction in moisture content from 60 percent to 10 percent.

4188 Ganther, W.D; Cole, I.S; Bhamornsut, C; Chotimongkol, L; Purwadaria, S; Hue, N.V. 2000. **A survey of moisture content of timbers in open and sheltered exposures across South East Asia**. Proceedings of 26th Forest Products Research Conference: Research developments and industrial applications and Wood Waste Forum, Victoria, Australia, 19-21 June 2000: 98-99. L. Schimleck; P. Blakemore, Eds. CSIRO Forestry and Forest Products, Clayton, Australia.

4189 Ginoga, B; Kamil, R.N. 1973. **Notes on the physical and mechanical properties of teak wood (*Tectona grandis* Linn.f.) from Sumbawa**. Laporan, Lembaga Penelitian Hasil Hutan 2: 2p.

4190 Gnanaharan, R; Ghosh, S.K; Balasundaran, M; Dhamodaran, T.K. 1984. **Predictors of ultimate strength of mistletoe-infested teak (*Tectona grandis* Linn.f.)**. Holzforschung 38(5): 293-295.

Static bending tests were carried out on mistletoe infested teak wood. Highly significant correlations were obtained between

MOR and MOE, MOR and fibre stress at proportional limit and MOR and density relationships. The strength of mistletoe-infested teak can be predicted in machine stress grading either by MOE or by FSPL.

4191 Higgins, N.C. 1957. **The equilibrium moisture content/relative-humidity relationships of selected native and foreign woods**. Forest Products Journal 7(10): 371-377.

The equilibrium moisture content - relative humidity relationships was studied for a number of commercially important woods including *Tectona grandis*. Data were presented on volumetric shrinkages, fibre saturation points, specific gravity and hysteresis loops for *Tectona grandis* along with other species both natural and when impregnated with phenolic resin.

4192 Hiromu, K; Mukudai, J. 1971. **Wetability of wood. VII. Heat of wetting of wood in water (2)**. (Japanese). Hyoto Furitsu Daigaku Gakujitsu Hokoku, Nogaku 23: 100-104.

Heat of wetting varied with wood species, wood constituents and composition and type of wood. Heat of wetting of woods rich in extracts was relatively low. Heat of wetting of sapwood slightly exceeded that of heartwood.

4193 Hojendahl, K. 1946. **Measurements of dielectric constant and dielectric loss of different wood species: Investigation of the dependency on direction, water content, frequency and temperature**. K. VetHojsk. Aarsskr 1-32.

Variation in dielectric constant with temperature was investigated for several species particularly teak.

4194 Hojendahl, K. 1948. **Measurements with Schering's bridge of dielectric constant and dielectric loss of different wood species**. Aarsskr. Vet.- Landbohojsk: 29-41.

Schering bridges were used to measure dielectric constant and loss of teak, in axial and radial directions. The dielectric constant increases with temperature and water content, but varies little with frequency.

4195 Immink, D.H. 1930. **Investigations into the physical properties of teak wood etc**. (Dutch; English). Meded Proefsta Boschw 18: 1-97.

The investigations on physical properties of teak and mahogany from experiments of Immink are compiled by Coster especially shrinkage of girdled and green teak.

4196 Imperial Forestry Institute. 1914. **Mechanical properties of teak from Nigeria**. Imperial Forestry Institute Bulletin 12: p360.

4197 Indira, E.P; Bhat, K.M. 1997. **Variability and heritability of wood density in teak (*Tectona grandis* Linn.f.)**. Journal of Tropical Forestry 13(1): 1-5.

Wood density variation was studied in teak clones and in provenances grown in Kerala. Analysis of the data showed that phenotypic coefficient was low for both clones and provenances and genotypic coefficient variation was negligible. The heritability on individual tree basis was low for clones while it was zero for provenances. Major part of the variation is due to tree-to-tree variation rather than provenances and hence selection of individual trees will help the improvement programme.

4198 Indira, E.P; Bhat, K.M. 1998. **Effects of site and place of origin on wood density of teak (*Tectona grandis*) clones**. Journal of Tropical Forest Science 10(4): 537-541.

The effects of site and clone origin on basic wood density of teak were studied in eighteen clones vegetatively propagated from plus trees and grown at two seed orchards in Kerala. It is showed that site had a highly significant influence on wood density, while place of origin of clones was less significant. No evidence of any interaction between site and clones could be detected.

4199 Jain, N.C; Dev, I. 1969. **Machining qualities of some Indian timbers**. Holzforschung und Holzverwertung 21(1): 12-18.

Out of the machining properties of timbers studied, it is found that teak has good machining propertis.

4200 Jain, V.K. 1992. **Stress-strain behaviour of teak (*Tectona grandis*) under repeated loading in compression**. Indian Forester 118(2): 142-147.

The elastic-plastic properties of air dried boards of *T. grandis* were studied under repeated loading-deloading cycles of compression parallel to grain. The results demonstrated the presence of the plastic part of strain even at low applied loads. Within the elastic limit, the wood starts to behave as elastic with repeated loading-deloading cycles.

4201 Jain, V.K; Arora, K.L; Sharma, A.K. 1993. **A note on the movement of some Indian timbers**. Indian Forester 119(11): 936-939.

Movement is the term applied to shrinkage and swelling of seasoned wood in service, due to fluctuations in atmospheric conditions. Movement is determined for six Indian species including teak between 32 and 93 percent relative humidity. Teak is found to have the least movement.

4202 Jain, V.K; Sanyal, S.N; Dangwal, M.N. 1988. **Irreversible stress-strain behaviour of some Indian timbers**. Journal of the Indian Academy of Wood Science 19(1): 63-70.

The stress-strain behaviour of wood is compared with that of ideal elastic materials using data from successive tests of tension strength and compressive strength parallel to the grain on specimens of eight species including teak. The test data of strain during loading and unloading for each type of strength test are presented, together with stress-strain curves drawn for *Tectona grandis* and *Cedrus deodara*.

4203 Kadita, H; Mukadai, J. 1971. **Studies on the wetability of wood. The heat of wetting of wood in water**. (Japanese). Scientific Reports of the Kyoto Prefectural University Agriculture 23: 100-104.

The total heat of wetting of the wood of thirty different softwoods, temperate hardwood and tropical hardwood species, and of major wood components were measured at 30 deg C. It is found that the total heat of wetting for water ranged from 12.65 to 18.60 cal/g of dry wood, was greater for sapwood than heartwood, was about the same for early and late wood, and was a little below average for woods of high extractive content e.g. *Dalbergia latifolia* and *Tectona grandis*.

4204 Kakkar, S.S. 1969. **Frequency dependence of dynamic elastic constant of wood**. Indian Forester 95(6): 418-424.

The dynamic elastic constant of wood parallel to the grain was determined for species including *Tectona grandis* by a sensitive flexural vibration technique. The calculated radiation constant was 40 percent higher for teak than for the other three species tested.

4205 Kelley, T.M. 1956. **U.S. Navy experience with carbides applied to woodworking machines**. Forest Products Journal 6(4): 159-161.

Among the instances of successful use cited is the machining of 150,000 linear feet of teak for decking without regrinding, as against 200 with high-speed steel.

4206 Kennedy, R.W. 1958. **Strength retention in wood decayed to small weight losses**. Forest Products Journal 8(10): 308-314.

A study of twelve species varying widely in origin, density and durability, were tested after controlled decay by *Polyporus versicolor* and *Poria monticola*. Strength loss, as measured by the modulus of rupture in static bending and work to maximum load, was less for *Polyporus versicolor* than for *Poria monticola*. Teak lost 27 percent in work to maximum load when the weight loss was 1 percent.

4207 Keylwerth, R; Christoph, N. 1960. **The study of thermal decomposition of wood by differential thermal analysis**. Materialprufung, Dusseldorf 2(8): 281-288.

Describes exploratory experiments, in which heat reactions and heat production of a test substance are investigated by comparing its thermogram with the differential temperature curve of an inert substance under identical conditions of gradual controlled heating. Thermograms of teak is presented along with other species.

4208 Koppel, C van de. 1948. **Is there a timber that can replace teak as decking for ships in the tropics**. (Dutch). Ber. Trop. Prod. Ind. Inst. Amst. 219: 9p (Schip en Werf 15(5), 1948: 78) .

Results of an enquiry made among a number of shipbuilders and shipping companies are discussed.

4209 Lim, S.C; Gan, K.S. 1998. **Density variation of Malaysian-grown teak**. Journal of Tropical Forest Products 4(2): 141-145.

The density of Malaysian-grown teak was found comparable to that of teak found elsewhere. Age had a significant effect on the density of the timber.

4210 Limaye, V.D. 1933. **Third interim report on project No.1 - physical and mechanical properties of woods grown in India**. Indian Forest Records (n.s.) Utilization 18(10).

4211 Limaye, V.D. 1935. **On growth rate and strength of teak**. Indian Forest Records (Economy series) 18: 10p.

4212 Limaye, V.D. 1939. **The comparative strengths of some important Indian timbers and their uses**. Indian Forest Records (n.s.) Utilization 1.A: 28p.

Teak and 35 other timbers were dealt in this paper.

4213 Limaye, V.D. 1942. **Interim report on the relation between rate of growth and strength of natural and plantation teak**. Indian Forest Bulletin (n.s.) Utilization 113: 13p.

It is reported that there is a significant correlation between the rate of growth and strength of teak. Rate of growth of about 5 to 6 rings per inch has been found to produce the strongest wood while a growth rate greater than about four rings per inch produces very weak timber. Plantation grown teak is found equal to natural teak as far as strength is concerned, although it is slightly lighter in weight and faster grown.

4214 Limaye, V.D. 1942. **Interim report on the rate of growth and strength of natural and plantation teak**. Indian Forester 68(7).

From the analysis of data on the rate of growth and strength of natural and plantation grown teak it is found that the rate of growth of about 5 to 6 rings per inch produce the strongest timber and a rate of growth faster than about 4 rings per inch produces very weak timber.

4215 Limaye, V.D. 1942. **Note on Indian timbers for aircraft and gliders**. Indian Forest Records (n.s.) Utilization 2: 168-177.

Brief notes on species suitable for aircraft construction and its distribution, availability and strength properties are provided. Teak will be used with synthetic resin glues.

4216 Limaye, V.D. 1944. **Suitability and selection of timbers for different uses. Parts I and II**. Indian Forest Records (n.s.) Utilization 3(5): 34p.

This bulletin provides comparable data on the properties of a number of timbers, as a guide in selecting the most suitable for different uses. Index figures and stick graphs are given to show the value of each timber in relation to teak with reference to weight, strength as a beam, suitability as a post, shock-resisting ability, retention of shape, shear and hardness.

4217 Limaye, V.D. 1953. **Standard terminology for describing timbers**. Indian Forester 79(2): 77-86 .

Taking teak as the standard, the physical and mechanical properties of some 100 Indian timbers are compared with it by index figures. The species considered are classified according to their weight, strength as beams, hardness, impact resistance and stability.

4218 Limaye, V.D. 1956. **Weights and specific gravities of Indian woods**. Indian Forest Records (n.s.) Timber Mechanics 1(4): 107p.

Presents tables of average weights and their maximum and minimum observed values for 300 consignments of wood species including teak. Approximate average weights of green logs of freshly felled trees are also calculated.

4219 Limaye, V.D; Seaman, L.N. 1933. **The physical and mechanical properties of woods grown in India**. Indian Forest Records (Economic Series) 18(10).

4220 Lin, J.L; Wang, S.Y. 1986. **Studies on the use of microwave irradiation to improve plasticity of wood. I. The effects of microwave irradiation on the moisture content and temperature of wood**. Forest Products Industries 5(2): 29-39.

Thirteen species were tested including teak to know the effect of irradiation on moisture content and temperature. After irradiation, moisture content was 1.3 times higher on the surface than in the inner parts of the wood; this would be beneficial for bending.

4221 Machacheep, Y. 1966. **Comparison of the hardness of teak timber from plantation of various ages in Lampang Province**. (Thai). Student Thesis. Kasetsart University, Bangkok.

A correlation was observed between hardness and age of plantation grown teak.

4222 Mang, W. 1958. **The blunting of rotary cutters in forward and counter motion**. (German). Mitt. dtsch. Ges. Holzforsch 40: 809p.

Results of the studies of the effect of glue-lines on blunting in the machining, testing the effect of types of glue, and age and thickness of glue-lines under various conditions of feed, cutter speed, cutting angle, tool materials etc. are presented. Preliminary tests on the effect of these variables were made on solid beech and teak and the merits of various criteria and methods for measuring wear are discussed.

4223 Moya, R; Cordero, L.D.P; Arce, V.H. 2003. **Wood density of *Tectona grandis* at two plantation spacing in Costa Rica**. Journal of Tropical Forest Products 9(1/2): 153-161.

A cross-sectional disc at diameter breast height was collected and found that wood basic density tended to increase with increasing age of cambium. Wood basic density was found to be higher at 6 x 2 m spacing than at 3 x 3 m spacing.

4224 Muchjacheep, Y. 1966. **Comparison of hardness of teak timber from plantations of various ages in Lampang province**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The age and hardness of teak is correlated and also age and density of teak wood. In 22 years hardness is high and at 5 years old it is low.

4225 Mukdasanit, B. 1959. **Study on correction factors used with capacity type electrical moisture metre for teak**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Gives the method and details of correlation factors working for the apparatus used.

4226 Mukherji, H.K; Bhattacharya, P.K. 1963. **A study of the correlation between different pairs of physical and mechanical properties of teak (*Tectona grandis*) grown in various localities of India and Burma**. Indian Forester 89(3): 207-217.

A high positive correlation was found between specific gravity and maximum crushing strength for both natural and plantation grown teak. Specific gravity could be used as an indicator of maximum crushing strength in certain localities, with a fairly high degree of precision.

4227 Nair, K.R; Mukherji, H.K. 1957. **A statistical study of the variability of physical and mechanical properties of *Tectona grandis* (teak) grown at different localities of India and Burma and the effects of the variability on the choice of the sampling plan**. Indian Forest Records (n.s.) Statistical 1(1): 49p.

Significant differences were found to exist in all the six properties tested, specific gravity, rings/inch, maximum crushing strength in compression parallel, modulus of rupture, modulus of elasticity and impact bending. It is indicated that no significant differences exist between specific gravity and rings/inch in general.

4228 Nair, K.R; Mukherji, H.K. 1960. **Classification of natural and plantation teak (*Tectona grandis*) grown at different localities of India and Burma with regard to its physical and mechanical properties**. FAO/TSC 60/4.13-4.14: 1-2.

The paper discusses the results of multi-variate analysis of data on important strength properties namely specific gravity, modulus of rupture, modulus of elasticity, and maximum crushing stress for samples of natural and plantation teak in the Indian Burma region tested at Forest Research Institute.

4229 Nair, K.R; Mukherji, H.K. 1960. **Classification of natural and plantation teak (*Tectona grandis* Linn.f.) grown at different localities of India and Burma with respect to its physical and mechanical properties**. Sankhya 22(1/2): 1-20.

Discusses the results of a multivariate analysis of data on strength properties such as specific gravity, modulus of rupture, modulus of elasticity and maximum crushing stress of teak from natural forests and plantation forests.

4230 Narayanamurti, D. 1960. **Movement of moisture in wood caused by a temperature gradient**. Norsk Skogind 16(12): 577-579.

Tabulated the results of experiments in Indian species including teak of density range, the rate of diffusion of moisture in cylinders of wood having a difference in temperature between the two halves.

4231 Narayanamurti, D; Bhargavarama, K.L. 1968. **The swelling and shrinkage of wood under mechanical restraint - some further experiments**. Drev-arsky Vyskum 2: 77-86.

Air-dry specimens of five Indian hardwoods including *Tectona grandis* placed in clamps were soaked and then oven-dried and repeated 10 times. The successive dimensional changes under tangential and radial restraint and for uncompressed controls are shown and also the course of swelling recovery on soaking the treated blocks. The cycling treatment increased density and compressive strength.

4232 Narayanamurti, D; Verma, G.M. 1972. **Swelling and shrinkage of wood under mechanical restraint. Influence of various factors on *Tectona grandis***. Holzforschung und Holzverwertung 24(4): 83-93.

Oven dry blocks taken from different positions in a tree of *Tectona grandis*, unextracted or extracted with water or organic solvents, were clamped tangentially or radially, and then soaked in water. Cycles of drying and wetting under restraint were repeated until no further shrinkage occurred. The rate of recovery and extent of setting at the end of the cycle were determined and found that the reduction in size was smaller for *T. grandis*.

4233 Narayanamurti, D; Zoolagud, S.S; Rangaraju, T.S. 1970. **Swelling and shrinkage of wood under mechanical restraint - influence of temperature**. Drev-arsky Vyskum 2: 43-50.

Oven-dried heartwood specimens of ten Indian hardwoods including *Tectona grandis* were subjected to a clamping/soaking/drying/measurement cycle. Soaking was done by keeping the test pieces in boiling water for five hours. Tabulated data from strength tests made after swelling recovery show that the cycling treatment improved compression strength.

4234 Negi, G.S; Bhatia, D.N. 1958. **Physical and mechanical properties of woods tested at F.R.I**. Indian Forest Records (n.s.) Timber Mechanics 1(2): 171-184.

Presents figures of physical and mechanical properties of logs of teak from Pyinmana Division Burma. The age of the tree is estimated to vary from 94-124 years. The timber can be classified as heavy, strong, moderately tough and hard.

4235 Orman, H.R. 1948. **Teak grown in Western Samoa**. New Zealand Journal of Forestry 5(5): 430-434.

Includes a comparison of mechanical and physical properties of green teak from Samoa and Burma.

4236 Pahlitzsca, G; Dziobek, K. 1959. **Investigations on belt sanding of wood with a straight cutting movement**. Holz als Roh- und Werkstoff 17(4): 121-134.

The influence of the sanding process of species including teak, fibre direction, size of sanding area, belt speed, pressure and fineness of abrasive was investigated by determining the volume of wood abraded.

4237 Patterson, D.G. 1964. **The colour question in teak and similar timber**. Wood 29(7): 47-48.

A note on the phenomenon of colour changes in freshly machined teak, for which a light-sensitive pigment of a tectoquinone derivative is responsible.

4238 Pearson, R.S. 1911. **Note on the relative strength of natural and plantation grown teak in Burma**. Indian Forest Bulletin 3.

Little difference was reported as regards strength of natural and plantation grown teak from Zigon Division, Burma. The natural grown teak is superior in the test of coefficient of transverse grain, but plantation teak strength is so high.

4239 Pearson, R.S. 1913. **A further note on the relative strength of natural and plantation grown teak in Burma**. Indian Forest Bulletin 14.

Comparative tests to determine the relative strength of plantation grown teak, with that of natural grown teak showed that percentage of moisture in teak has no marked effect when transverse strain is applied.

4240 Pearson, R.S; Brown, H.P. 1932. **Commercial timbers of India, their distribution, supplies, anatomical structure, physical and mechanical properties and uses**. Government of India, Central Publication Branch, Calcutta. Vol. II: 794-796.

Gives notes on common Indian woods including teak.

4241 Prasad, B.N; Jain, N.C. 1964. **Preliminary studies of cutting resistance of a few Indian woods**. Indian Forester 90(10): 698-701.

Describes the apparatus pendulum dynamometer and some preliminary results of tests on a number of species including teak.

4242 Purkayastha, S.K; Tandon, R.D; Rao, K.R. 1973. **A note on the variation in wood density in some 36-year-old teak trees from different seed origins**. Indian Forester 99(4): 215-217.

Studies of increment of *Tectona grandis* from four seed origins in South Coimbatore, and two of the same seed origins in Nilambur, indicated that environmental influences has a greater effect than seed source on the density of the mature wood.

4243 Rajput, S.S; Shukla, N.K; Sharma, R.R. 1980. **Mechanical tests for wood. Comparison of test results on large and small size specimens**. Holzforschung und Holzverwertung 32(5): 117-120.

Comparative tests for static bending, compression parallel to grain and perpendicular to grain, hardness and shear parallel to grain were made on specimens of *Tectona grandis* and other species from three sites. The results were analysed and the ratios of strength properties of large specimens to those of small specimens were calculated.

4244 Rajput, S.S; Shukla, N.K; Sharma, R.R. 1983. **Some studies on the comparison of strength of sapwood and heartwood of teak and kokko**. Journal of the Timber Development Association of India 24(4): 24-30.

Static bending, compression parallel to the grain, hardness, impact strength and green and oven dry density were measured in heartwood and sapwood of *Tectona grandis* and *Albizia lebbek*. The heartwood of both species had significantly better strength properties than the sapwood.

4245 Rajput, S.S; Shukla, N.K. 1986. **A note on the strength-moisture relationship for wood**. Journal of the Timber Development Association of India 32(4): 8-12.

Maximum crushing strength was determined for *Tectona grandis* and other species dried to moisture content of 6-34 percent.

4246 Rajput, S.S; Shukla, N.K; Lal, M. 1991. **Some studies on the variation of strength properties of *Tectona grandis* from Mizoram**. Journal of the Timber Development Association of India 37(2): 33-38.

Results are presented of a study on the variations in physical and mechanical properties of plantation grown teak. Average specific gravity and strength were comparable to values obtained from other localities in India.

4247 Rajput, S.S; Shukla, N.K. 1992. **Status of research on variation of strength of timber in India**. Indian Forester 118(9): 630-637.

A short review is presented of variation in strength properties of timbers including teak. Data are given on the maximum and minimum values found for important strength properties in the green condition, noting the lightest and toughest species. Data on species variation are given for teak and *Eucalyptus hybrid* from various localities, and variation found with age and growth rate are briefly mentioned.

4248 Rawat, B.S; Rana, G.S. 1960. **Mechanical properties of teak from Andamans**. FAO Teak Sub-Commission, New Delhi, 1960, FAO/TSC-60/4.10: 3p.

Presents the results of the tests with comparative data.

4249 Rehman, M.A; Gupta, H.K. 1961. **Shrinkage studies on Indian timbers. Part 1. *Tectona grandis* (teak)**. Indian Forest Records (n.s.) Wood Seasoning 1(3): 29-43.

Presents the results of the studies conducted on shrinkage properties of two logs of girdled Burma teak.

4250 Ryan, A; Kloot, N.H. 1960. **Some notes on the mechanical properties of teak (*Tectona grandis*)**. FAO Teak Sub-Commission, New Delhi FAO/TSC-60/4.8: 4p. Food and Agricultural Organization of UNO, Rome.

The important properties of teak for structural design of both natural and plantation grown teak are tested. In early years of growth, strength properties are low and tend to rise slowly every year till 20 years. Teak grown in certain areas is different from that grown in other areas. Recommendations are made on detailed study of strength by density and strength vs. age diameter relationships.

4251 Sahri, M.H. 2003. **Physical and mechanical properties of thinning materials of teak (*Tectona grandis*) planted in Malaysia**. IUFRO Division 5 Conference, Rotorua, 11-15 March 2003.

4252 Sallenave, P. 1957. **Radial and tangential shrinkage of wood**. (French). Bois et Forests des Tropiques 1957 56: 45-50.

Describes the methods employed for the quantitative determination of radial and tangential shrinkage of wood including teak.

4253 Sallenave, P. 1958. **The wood of African grown teak**. Bois et Forests des Tropiques 57: 37-48.

Samples of teak from the Far East and West Africa are compared for its strength properties.

4254 Sanwo, S.K. 1986. **Intra-tree variations of strength properties in plantation grown teak (*Tectona grandis* Linn.f.) and techniques for their systematic sampling**. Oxford Forestry Institute, University of Oxford, OFI Occasional Papers 31: 41p.

Density, MOR, MOE, total work done and maximum compressive strength parallel to grain were determined in static bending and compression tests of plantation grown teak at Ibadan, Nigeria. Systematic variation was found in oblique, horizontal and vertical sequences.

4255 Sanwo, S.K. 1986. **Prediction of modulus of rupture from modulus of elasticity for plantation grown teak (*Tectona grandis* Linn.f.) in Nigeria**. Journal of Tropical Forest Resources 2: 18-22.

Nominal specific gravity and moduli of rupture and elasticity were determined for green, clear, small, non-standard specimens from a plantation at Ibadan, Nigeria. Simple correlation and regression analysis showed that MOR was highly correlated with MOE. A significant positive correlations between MOR or MOE and SG is also reported. A linear regression model was developed to predict MOR from MOE.

4256 Sanwo, S.K. 1986. **The relationship between rate of growth and strength in plantation grown teak (*Tectona grandis* Linn.f.)**. Journal of Tropical Forest Resources 2: 9-17.

Results of an examination of the relations between rate of growth and wood characteristics such as specific gravity, modulus of rupture, modulus of elasticity, toughness, maximum compressive strength parallel to grain in a plantation at Ibadan, Nigeria are presented. It is reported that the rate of growth has no significant influence on specific gravity and strength properties of plantation grown teak.

4257 Sanyal, S.N; Bali, B.I; Singh, K.R; Sharma, B.D. 1987. **A note on the physical and mechanical properties of plantation grown *Tectona grandis* (teak) from Tanjavur District, Tamil Nadu**. Journal of the Timber Development Association of India 33(4): 15-22.

Plantation-grown teak was classified as heavy, strong, moderately tough, very steady, hard timber. Physical and mechanical properties of this teak were reported better than those of standard teak from Malabar, Coimbatore and Nilambur.

4258 Sanyal, S.N; Saxena, R.C. 1980. **Physical and mechanical properties of some Maharashtra timbers**. Journal of the National Buildings Organisation, India 25(1): 1-5.

Physical and mechanical properties were tested for nine timbers which include teak from Maharashtra in western India. Results are tabulated for green, air-dried and kiln-dried specimens and discussed the relation to working properties and uses.

4259 Sanyal, S.N; Saxena, R.C. 1982. **Physical and mechanical properties of some Maharashtra timbers**. Journal of the National Buildings Organisation, India 27(2): 1-6.

Data are tabulated for timbers including teak.

4260 Sattar, M.A. 1983. **Effects of moisture content and steaming period on the bending properties of teak wood**. Bano Biggyan Patrika 12(1/2): 12-16.

4261 Sattar, M.A; Ali, M.O. 1978. **Shrinkage and density studies of teak of various age groups**. Bano Biggyan Patrika 7(1/2): 82-87.

Density and tangential, radial and longitudinal shrinkage were measured. Both shrinkage and density were independent of height variation with age was small.

4262 Schwab, E. 1986. **Properties of hardwoods in compression perpendicular to grain**. Holz als Roh-und Werkstoff 44(7): 259-269.

Load deformation curves were used to analyse relations between properties measured under compression perpendicular to grain.

4263 Sekhar, A.C. 1960. **Progress report on investigation relating to the mechanical and physical properties of teak at Forest Research Institute, Dehra Dun**. FAO Teak Sub-Commission, New Delhi FAO/TSC-60/4.12: 4p.

Investigations on the mechanical and physical properties of both natural and plantation grown teak specimens were carried out at Dehra Dun. Splitting qualities, shrinkage in natural grown teak and comparative studies on green and kiln dry teak were also investigated. A significant positive correlation is reported existing between specific gravity and maximum crushing strength of teak.

4264 Sekhar, A.C. 1967. **Some Indian timbers equivalent to foreign timbers**. Van Vigyan 5(1/2): 18-24.

Briefly describes reasons for India's dependence on imported timber and wood products, and tabulates the specific gravity and the strength and dimensional stability of sixty six Indian and twenty imported timbers including teak, indicating the manufactured products for which they are suitable.

4265 Sekhar, A.C; Bhatia, D.N. 1957. **Physical and mechanical properties of woods tested at the Forest Research Institute, Dehra Dun: Report VIII**. Indian Forest Records (n.s.) Timber Mechanics 1(9): 155-157.

It deals with the properties of timbers including *Tectona grandis*. Data are recorded for wood in the green state and air-dry.

4266 Sekhar, A.C; Bhatia, D.N. 1959. **Note on the evaluation of splitting coefficients of tim-**

ber. Indian Forest Bulletin 222 (Timber Mechanics): 7P.

Gives the splitting coefficient of common Indian timber including *Tectona grandis*.

4267 Sekhar, A.C; Bhatri, R.K; Rawat, M.S. 1960. **Comparative studies on natural and plantation teak**. Indian Forest Bulletin (n.s.) 227: 10p.

Natural and plantation grown teak from four localities in India and one in Burma were tested for strength properties. No significant differences were identified between natural and plantation teak.

4268 Sekhar, A.C; Gulati, A.S. 1974. **Cleavage properties of some Indian timbers**. Indian Forest Bulletin 269: 20p.

Reports some preliminary studies of cleavage resistance of green wood of *Tectona grandis* using round-notched specimens of various lengths and widths. The effect of specific gravity on cleavage resistance is discussed and suitable equations are proposed.

4269 Sekhar, A.C; Negi, G.S. 1961. **Studies of variation of strength properties in wood. Variation from pith to periphery across the diameter in a tree**. Indian Forester 87(2): 87-93.

Variations from pith to periphery in specific gravity, fibre stress at elastic limit, modulus of rupture, modulus of elasticity, and maximum crushing stress for green wood of different species including *Tectona grandis* are studied.

4270 Sekhar, A.C; Negi, G.S. 1966. **Variation of some mechanical properties along the length of teak trees**. Indian Forest Bulletin (n.s.) 251: 11p.

Variation of strength in stem with position followed the same trend as specific gravity, i.e. strength was greater at the butt and top, and relatively lower in the intermediate positions. The variation was greater in plantation-grown than in natural teak.

4271 Sekhar, A.C; Rajput, S.S. 1970 . **Third report on testing of wood poles**. Indian Forest Bulletin (n.s.) Timber Mechanics 262: 23p.

Gives the results of tests on full length and jointed poles of nine species including *Tectona grandis*. Relations between tests on small specimens and full-length poles have been established. Effects of taper, defects, failures and moisture content have also been studied.

4272 Sekhar, A.C; Rana, R.S. 1957. **Physical and mechanical properties of woods tested at the Forest Research Institute, Dehra Dun. Report IX**. Indian Forest Records (n.s.) Timber Mechanics 1(10): 153-155.

Gives tabulated data on woods including *Tectona grandis*.

4273 Sekhar, A.C; Rana, R.S. 1959. **Physical and mechanical properties of woods tested at the Forest Research Institute, Dehra Dun Report IX**. Indian Forest Records (n.s) Timber mechanics 1(10): 163-165.

Tectona grandis is one of the species for which the physical and mechanical properties has been tested.

4274 Sekhar, A.C; Rawat, B.S. 1956 . **Torsional properties of some Indian timbers**. Indian Forest Bulletin 22: 13p.

Gives basic torsional data on eighty five consignments of woods including *Tectona grandis*.

4275 Sekhar, A.C; Rawat, B.S. 1966. **Physical and mechanical properties of teak from different localities in India and neighbouring areas**. Indian Forest Records (n.s.) Timber Mechanics 1(13): 197-212.

Data on testing of teak for its physical and mechanical properties from different localities in continental India and Burma are tabulated.

4276 Sekhar, A.C; Sanyal, S.N; Sarin, S.P. 1972. **Dynamic modulus of elasticity and pulse constant of wood by pulse transmission technique**. Journal of the Timber Development Association of India 18(4): 19-24.

The dynamic moduli of elasticity and pulse constants of five Indian species including *Tectona grandis* were determined by measuring the velocity of ultrasonic pulses along the grain. Data are given for the pulse velocity in *Tectona grandis* parallel and perpendicular to the grain.

4277 Sekhar, A.C; Sharma, R.S. 1956. **Variation of Izod values with temperature in timber**. Indian Forester 82(1): 45-48.

A study was made of the variation of Izod values with temperature, on standard specimens of seven species including *Tectona grandis*. The test data are tabulated and straight-line equations suggested for each species separately. Slight increases of Izod values with increases in temperature at moisture content above fibre-saturation point were observed.

4278 Sekhar, A.C; Sharma, R.R. 1966. **Nails and screws holding power of some Indian timbers under dynamic conditions**. Indian Forester 92(7): 477-481.

Describes the test method and gives results for timbers including *Tectona grandis* of two provenances.

4279 Sekhar, A.C; Shukla, N.K. 1966. **Creep of wood beams under certain load and its effect on basic strength**. Journal of National Buildings Organisation, New Delhi 11(2): 14-18.

Discusses the results of strength tests on teak beams along with three other spp., before and after deformation under loads.

4280 Sekhar, A.C; Singh, K.R. 1978. **A note on the physical and mechanical properties of *Canarium strictum* Roxb. (dhuna) from Assam**. Indian Forester 104(2): 96-105.

Physical and mechanical properties are tabulated for green air-dry and kiln-dry specimens. Data for teak are included for comparison.

4281 Shigematsu, Y. 1956. **Tests of tropical woods. Part 1. Mechanical properties of seven Philippine woods and two Thai woods**. (Japanese). Scientific Reports of the Saikyo University (Agriculture), Kyoto 8: 20-25.

Compressive strength, bending strength, Young's modulus in bending and hardness are related to specific gravity of *Dipterocarpus* spp. and *Tectona grandis*. Anatomical structure is also found affecting strength.

4282 Shukla, N.K; Rajput, S.S. 1997. **Physical and mechanical properties of Haryana timbers**. Van Vigyan 35(1): 21-29.

Data are tabulated and discussed on the physical and mechanical properties and suitability indices for various utilization characteristics of thirty three timber species including teak grown in Haryana.

4283 Shukla, N.K; Sangal, S.K. 1986. **Preliminary studies on strength properties of some exotic timbers**. Indian Forester 112(5): 459-465.

Physical and mechanical properties including density, modulus of rupture, modulus of elasticity, compression, surface hardness and shear parallel to the grain were recorded for samples of different exotic trees and compared with teak. Teak was found stronger than most of the species.

4284 Sim, H.C; Lopez, D.T; Mohd Arshad, S. 1979. **Sawing of locally grown teak (*Tectona grandis*)**. Malaysian Forester 42(3): 225-229.

Bandsawing trials were made on logs of 10-19 inches mid-diameter from Peninsular Malaysia.

4285 Smeathers, R. 1951. **A comparative study of some of the more important mechanical and physical properties of Trinidad and Burma grown teak (*Tectona grandis*)**. Institute Paper, Imperial Forest Institute, Oxford 27: 19p.

From the mechanical and physical properties tested it is found that the timber grown in the teak plantations of Trinidad is in no way inferior to that of Burma-grown teak. A positive correlation existed between all strength properties and specific gravity.

4286 Sono, P. 1962. **Study on the effects of cross grain on mechanical properties of Thai timbers. Part I. The effects of cross-grain on mechanical properties of Teak (*Tectona grandis*)**. Royal Forest Department, Bangkok 47: 9p. FAO, Rome.

Presents tabulated and graphed results of tests on boards of 40-year teak, with statistical analyses of values obtained for fibre-stress at proportional limit, moduli of rupture and elasticity, maximum crushing strength etc.

4287 Sono, P; Rativanichi, T. 1964. **Comparative study on properties of plantation and natural grown teak in Thailand**. Bulletin, Royal Forest Department, Ministry of Agriculture, Bangkok R. 65: 6p.

Five sample trees from a plantation and from natural forest were tested for physical, mechanical and chemical properties. The only significant differences were in ash content and hot-water solubility, which were respectively greater and less in plantation-grown wood.

4288 Sono, P; Saengsakul, P. 1959. **A Preliminary study on the physical and mechanical properties of different types of teak in Thailand**. Royal Forest Department, Bangkok R 32: 8p.

The so-called sak tong, sak yuak, sak hin, sak khi-kwai possess no statistically significant difference of physical and mechanical properties except sak khi-kwai which shows some significant values in green test.

4289 Sparkes, A.J. 1972. **The strength of teak joints**. FIRA Bulletin 10(37): 10-11.

It is found that the joints of *T. grandis* were generally weaker than those of Beech, probably because of the variable strength properties and the presence of extractives that prevent the formation of a strong bond initially, and loss of strength due to shrinkage under dry conditions. Means of correcting these defects are suggested, including the use of suitable solvents in the glue.

4290 Tamolang, F.B; Rocafort, J.E. 1987. **Physico mechanical properties and possible uses of eleven plantation grown timber species in the Philippines**. FPRDI Journal 16(1/2): 75-85. Forest Products Research and Development Institute, Laguna, Philippines.

Properties studied included relative density, shrinkage, bending, shear parallel to grain, compression parallel and perpendicular to grain, hardness and toughness. Based on the classification of the species in accordance with the five physico-mechanical property teak is recommended for medium construction purposes.

4291 Thomas, A.V. 1940. **Malayan timbers tested in a green condition**. Malaysian Forester 9: 151-157.

A comprehensive table is given of the strength properties of thirty three Malayan timbers in the green condition and corresponding figures for Scots pine, oak and teak are appended for comparison.

4292 Venet, J. 1955. **Wood and warships, merchant vessels and pleasure boats**. (French). Revue du Bois et de ses Applications 10(1): 17-24.

A brief outline of the history of wooden sea-going vessels from the earliest times is followed by a list of the present uses of wood for naval purposes and of the species involved including teak.

4293 Vernay, M. 2000. **Teak in France: What for?** (French). Bois et Forests des Tropiques 263: 31-38.

Teak is used for prestigious purposes such as the interior fittings of boats, parquet flooring, furniture, and many other uses in France. The increase in demand for products seems to be upsetting the market and prompting producers to use younger and younger teak trees in order to meet the demand which led to rise in prices, which go hand in glove with lower product quality.

4294 Wang, S.Y. 1981. **Studies on the properties of wood deterioration (VI) The reduction in strength properties of some Taiwan native species after 4 years exposure in outdoor environment**. Quarterly Journal of Chinese Forestry 14(4): 29-39.

Weathering resistance of samples of seventeen species including *Tectona grandis* was tested by the accelerated method or by exposing them outdoors for four years. Static and impact bending strength were measured as indicators of weathering resistance and decreased linearly with increasing length of exposure to outdoor environment.

4295 Wang, S.Y. 1990. **Reduction of mechanical properties of seventeen Taiwan native-wood species subjected to a seven-year exposure in an outdoor environment**. Journal of the Japan Wood Research Society 36(1): 69-77.

Changes in specific gravity in static and impact bending strengths were used to indicate the weathering resistance of samples including *Tectona grandis*. Effects on the mechanical properties were in the order impact bending strength modulus of rupture modulus of elasticity. Changes in mechanical properties also varied with climate.

4296 Wattankul, S. 1959. **A comparative study on the physical properties of green-felled and girdled teak timbers (*Tectona grandis*)**. Royal Forest Department, Bangkok R.33: 22p.

Results of investigations are summarised and variations in moisture content of green and girdled logs is given at different points of heartwood and also at butt end and top piece of the same log. The variation in moisture content of logs in different seasons of the year is studied.

4297 Williams, R.S; Miller, R; Gangstad, J. 2001. **Characteristics of ten tropical hardwoods from certified forests in Bolivia. Part I: Weathering characteristics and dimensional change**. Wood and Fiber Science 33(4): 618-626.

Ten tropical hardwoods including teak from Bolivia were evaluated for weathering performance. The dimensional change for teak was 1.3 and 2.5 percent for the same change in relative humidity. The erosion rate of several of the wood species was considerably slower than that of teak.

4298 Win Maung, U. 1968. **Comparative load tests on simple timber connectors for Burmese hardwoods**. Union of Burma Journal of Science and Technology 1(3): 499-518.

Presents preliminary results of working-stress tests with wire nails, wood screws, bolts and nuts, and improvised split-ring connectors, used in conjunction with wood of *Tectona grandis* and other species.

4299 Woods, R.P. 1952. **Timber for ships decking**. Timber Development Association, London, Timber Information 42: 2p.

Discusses the results of service tests on timbers including teak laid down as decking.

4300 Yakub, M; Ali, M.O; Bhattacharjee, D.K. 1970. **Strength properties of some East Pakistani woods, some Bangladesh timber species, Chittagong teak *Tectona grandis* representing different age groups**. Bulletin, Forest Research Institute, Bangladesh 1, 1970: 14p; 2, 1972: 12p; 4, 1978: 28p.

4301 Zeeuw, C.H de; Davidson, R.W; Anderson, E.A. 1980. **Properties of the wood of Honduran grown *Tectona grandis* Linn.f., *Eucalyptus deglupta* Blume, and *Pinus caribaea* Morelet**. Procesamiento de maderas tropicales de alta densidad. Acta de la reunion de IUFRO: 22p. Laboratorio Nacional de Productos Forestales, Merida, Venezuela.

Physical and mechanical properties of wood are presented and discussed for plantation-grown *Tectona grandis* and *Eucalyptus deglupta* and for naturally-occurring *Pinus caribaea*. The results showed that, wood density was lower for plantation-grown trees than for naturally-grown trees.

Go top

Chemical Properties

4302 **Chemistry of teak: News and notes**. Indian Forester 93(2), 1967: p136.

Recent German studies indicate that almost all the anthraquinones found in teak wood are effective against termites. But naphthoquinones, especially desoxylepachol are found fungicidal. Some varieties of teak cause unpleasant skin diseases, specially lapachol and depsoxypachol. The high caoutchouc content of the wood is responsible for its good abrasion resistance, its resistance to mineral acids.

4303 **Thailand research team finds trace of gold in teak wood**. Forest Products Journal 18(12), 1967: p11.

Studies conducted by Atomic Energy for Peace, Bangkok show that teakwood contain gold.

4304 Amos, G.L. 1952. **Silica in timbers**. Commonwealth Science Industrial Research Organization Bulletin 267: 55p.

Teak wood contains vitreous silica in the vessels and parenchyma but the amount present in specimens of timbers varies over a wide range.

4305 Aranyaputi, S. 1963. **A study of chemical property of teak**. Vanasarn 21(2): 157-162.

The chemical contents of tectoquinone, lapachol, caout-chouc and tectol in teak were studied in detail and chemical composition presented.

4306 Bhatia, K; Jia Lal; Ayyar, K.S. 1985. **Barks as a source of oxalic acid - I**. Indian Forester 111(7): 538-541.

Of the 31 forest species examined *Tectona grandis* bark is found to have 8.3-15.55 percent of oxalic acid.

4307 Bouda, V. 1968. **Finishing of exotic timbers containing aliphatic and resinous substances in the furniture industry**. (Czech). Drev 23(7): 248-252.

Reports tests on different species including teak.

4308 Bromley, R.F; Rudge, E.A. 1939. **The hardness of teak in relation to its mineral constituents**. Chemistry and Industry Review 58: 279-280 .

It appears probable that the hardness in teak is due to some histological factor, closeness of grain, cell structure or fibre orientation.

4309 Burmester, A. 1971. **Improvement of wood with formaldehyde. I. Influence of various factors on the degree of improvement**. Holz als Roh-und Werkstoff 29(2): 51-56.

Treatment of wood with formaldehyde gas followed by HCl gas leads to improvement in its dimensional stability owing to the formation of chemical bonds with hydroxyl groups in the wood. The reduction in swelling of wood including teak is recorded in relation to the amount of formaldehyde fixed in the wood.

4310 Burmester, A. 1971. **Improvement of wood with formaldehyde. III. Treatment of reactivated heartwood**. Holz als Roh-und Werkstoff 29(5): 184-188.

The product has improved dimensional stability due to cross-linking, the relative tangential swelling being reduced by up to 80 percent. Effects of moisture content of the wood and treatment conditions were investigated.

4311 Burmester, A. 1974. **Dimensional changes in oven dry wood by re-deposition of water soluble substances in the cell wall**. (German). Holz als Roh-und Werkstoff 32(6): 229-233.

Measurements on cubes of species including *Tectona grandis* showed that the oven-dry dimensions were influenced by the method of drying. Changes in dry dimensions after wetting and drying cycles are not due to drying stresses but to distribution of water-soluble substances within the cell-walls.

4312 Coster, C. 1923. **Thickness and contents of stem of *Tectona grandis***. (Indonesian; English). Tectona 16(11/12): 1046-1056.

4313 Councler. 1907. **Chemistry of teak wood**. (German; English). Zeitschrift fur Forst. U-Jagdwesen 39: p814.

4314 Datta, S.K; Kumar, A. 1987. **Histochemical studies of the transition from sapwood to heartwood in *Tectona grandis***. IAWA Bulletin 8(4): 363-368.

Discs from young branches prior to heartwood formation and from older branches with heartwood were separately analysed. Starch, lipids, proteins, nucleic acids, phenolics, peroxidase, succinate dehydrogenase, acid phosphatase, adenosine triphosphatase and glucose-6-phosphatase showed significant changes during the transition.

4315 Devi, R.K.S; Devi, G.A.S. 1990. **Cell wall biochemistry of timbers from Manipur**. Indian Forester 116(10): 843-844.

Contents of cellulose, hemicellulose, lignin and pectin are reported for the wood of seven species including teak, which was ground to a powder after oven drying and then analysed.

4316 Dutt, S. 1961. **Indian oleoresins and their essential oils**. Indian Oil Soap 27(1): 3-10.

A review of the physical and chemical properties of *Tectona grandis* and other species and their oleoresins and essential oils.

4317 Elias, M; Potvin, C. 2003. **Assessing inter and intra specific variation in trunk carbon concentration for 32 neotropical tree species**. Canadian Journal of Forest Research 33(6): 1039-1045.

Trunk carbon concentrations were assessed for 32 species of tropical trees including teak to understand sources of variation. Teak demonstrated the greatest C concentration. C concentration was highly correlated with specific gravity of wood.

4318 Faix, O; Meier, D. 1989. **Pyrolytic and hydrogenolytic degradation studies on lignocellulosics, pulps and lignins**. Holz als Roh-und Werkstoff 47(2): 67-72.

Wood and milled-wood lignin from species including teak wood and teak HCl-lignin were subjected to analytical pyrolysis. The results are compared with those of nitrobenzene oxidation and quantitative non-degradative FTIR-spectroscopy. It is concluded that analytical pyrolysis of biomass is well suited for lignin classification even without previous lignin isolation.

4319 Forest and Forest Products Research Institute, Japan. 1978. **Properties of some Papua New Guinea woods relating with manufacturing processes. VII. Chemical properties of some West New Britain woods**. (Japanese). Forest and Forest Products Research Institute, Japan, Bulletin 299: 85-104.

Results are tabulated for successive extraction with n-hexane, ether, acetone and methanol. Discoloration was investigated in response to ferrous ions, alkali, acid, and exposure to sunlight.

4320 Griffoen, K. 1950. **Carbonization of some Indonesian woods in an electrical laboratory oven**. (Dutch; English). Tectona 40: 241-258.

Gives the properties of charcoal and ash of teak wood.

4321 Gupta, R.C; Jain, D.K. 1980. **Role of extractives in the development of bond strength**. Indian Forester 106(8): 565-568.

Lap joints were made with cold-set UF resin of sawn and sanded strips of species including teak after extraction in hot water, ether, ether and benzene/alcohol and combined ether and benzene/alcohol and hot water. Extraction in hot water reduced bond strength after 7 days whereas in ether, ether and benzene/alcohol and combined ether and benzene/alcohol and hot water it was increased.

4322 Hausen, B.M; Simatupang, M.H; Tamolang, F.N. 1979. **Naturally occurring quinones in tropical woods as allergenic agents**. Wood quality and utilization of tropical species. Proceedings of IUFRO conference, Laguna, 30 October-3 November 1978: 74-82. Forest Products Research and Industries Development Commission, Laguna, Philippines.

Some 10 allergenic quinones are discussed in relation to the species including teak in which they occur and their effects. A table is given of tropical woods that contain quinones implicated in contact allergies.

4323 Hillis, W.E; De Silva, D. 1979. **Inorganic extraneous constituents of wood**. Holzforschung 33(2): 44-53.

4324 Hirano, Y; Kondo, R; Sakai, K. 2001. **Compounds inhibitory to rat liver 5alpha-reductase from tropical commercial wood species: Resveratrol trimers from melapi (*Shorea* sp.) heartwood**. Journal of Wood Science 47(4): 308-312.

5alpha-Reductase inhibitory activity of methanol extracts of the heartwood of thirteen tropical wood species including *Tectona grandis* were examined.

4325 Kafuku, K; Sebe, K. 1963. **On tectoquinone, the volatile principle of the teak wood**. Bulletin Chemical Society, Japan 7: 14p.

4326 Kanazawa, H; Nakagami, T; Nobashi, K; Yokota, T. 1978. **Studies on the gluing of the wood articles. XI. The effects of teak wood extractives on the curing reaction and the hydrolysis rate of the urea resin adhesive**. Mokuzai Gakkaishi Journal of the Japan Wood Research Society 24(1): 55-59.

The methanol-insoluble fraction of the hot water extract of teak retarded the gelation of a urea resin adhesive. Inhibition was attributed to Ca, Mg and K salts of acidic sugars, which have a buffering action on the glue hardener system. The methanol-soluble fraction of the extract increased the rate of hydrolysis of the cross-linked cured urea resin, owing to its acidity.

4327 Karnik, M.G; Bhatia, K; Dobhal, P.C. 1970. **The proximate chemical composition of barks of some Indian trees: Part I**. Indian Forester 96(4): 314-317.

The bark of *Tectona grandis* and other species were analysed for tannins, cold-water solubility, hotwater solubility, ash, peat, ether extractives, alcohol benzene extract, pentosans, lignin and chlorite holocellulose content following standard methods. The barks were also tested qualitatively for starch and alkaloids.

4328 Karnik, M.G; Gupta, A.C. 1966. **Significant chemical components of Indian teak (*Tectona grandis* Linn.f.)**. Indian Pulp Paper 20(8).

Based on chemical studies of major constituents of Indian teak wood, extractives of lignin, total carbohydrates, hemicellulose, pentosans, ash, acetyl content and silica in the wood were estimated. The wood was also tested qualitatively for sugars, starch, alkaloids and tannins.

4329 Kawamura, F. 1999. **Components of tropical trees and their utilization (7) Food colourants**. Tropical Forestry 44: 77-80.

Different species are used which include *Tectona grandis*.

4330 Kawazu, K; Marwani, E; Kobayashi, A; Nitoda, T; Kanzaki, H. 1998. **Production of antibacterial triterpene acids not detected in the native plant by cell suspension culture of *Tectona grandis***. Faculty of Agriculture, Okayama University, Scientific Reports 87: 9-12.

The paper reports the production of the antibacterial compounds in much higher amounts by cell suspension culture.

4331 Khan, R.M; Mlungwana, S.M. 1999. **5-Hydroxylapachol: A cytotoxic agent from *Tectona grandis***. Phytochemistry 50(3): 439-442.

A new compound, 5-hydroxylapachol, lapachol, dehydro-alpha-lapachone, methylquinizarin and squalene, were isolated from the root heart wood of *T. grandis*.

4332 Kraenzel, M; Castillo, A; Moore, T; Potvin, C. 2003. **Carbon storage of harvest age teak (*Tectona grandis*) plantations, Panama**. Forest Ecology and Management 173(1-3): 213-225.

Estimated carbon content of 20- year old teak trees in four Panamanian plantations. Various methods of estimation of carbon storage in short rotation plantations are discussed.

4333 Kristensen, P; Boye, C; Jensen, B. 1965. **Testing dowels**. (Danish). Troeindustrien 15(2): 15-19.

Studies the effect of type of glue and method of gluing and type of dowel on strength of dowelled joints in beech and teak.

4334 Lee, C.L; Nakatsuka, T. 1972. **Effect of methanol extractives of woods on the curing characteristics of unsaturated polyester resins at 25 degree C**. (Japanese). Mokuzai Kogyo Wood Industry 27(6): 17-21.

Curing of the resins was delayed by the addition of 1 percent of methanol extractives of most of the 14 softwood and 4 hardwood species examined. Considerable delay was observed with extractives from species including *Tectona grandis*.

4335 Lii, W.J; Liu, C.T. 1991. **Effect of physicochemical properties and gluing methods on the qualities of laminated wood made from fast-growing species (12). Studies on the fabrication of end-to-end grain joint laminated wood from Taiwan red pine, Honduras mahogany and common teak**. (Chinese). Forest Products Industries 10(1): 25-34.

Bending strength was compared of laminated wood made from teak and other species with butt, scarf or finger joints at different locations.

4336 Moredo, C.C Jr; Sakuno, T; Kawada, T; Furukawa, I. 1990. **Effect of extractives on gluability of wood. I. Gluability of some tropical woods after solvent extraction**. Journal of the Faculty of Agriculture, Tottori University 26: 19-28.

Wood extractives of different species including teak were removed by solvent extraction in a study to determine whether removal of extractives would improve gluability. Wood block samples, treated and untreated, were bonded with isocyanate, resorcinol and polyvinyl acetate resins and their glue bond strength properties were investigated.

4337 Narayanamurti, D (et al). 1962. **Extractives in teak**. Silvae Genetica 11(3): 57-63.

Disks from the butt end of trees of 10, 30 and 62 years old were investigated along the radius for variations in extractive content and durability.

4338 Narayanamurti, D; Singh, J. 1960. **Caout chouc in teak**. Composite Wood 7(4): 39-41.

Describes preliminary studies made at Dehra Dun, in which specimens of Burmese and Indian grown teak were examined for their caoutchouc content. Results indicated that bending strength, moisture resistance and dimensional stability are adversely affected by removal of caoutchouc but the modulus of elasticity is improved.

4339 Narayanamurti, D; Singh, J. 1964. **Note on caout chouc in teak**. Silvae Genetica 13(5): 140-141.

Compares the caoutchouc content of wood from three seed origins, Mysore, Mount Stuart and S. Burma. Wood from Mysore is found having the highest content.

4340 Narayanamurti, D; Verma, G.M. 1963 . **Nature and distribution of extractives in Indian wood species**. (German). Holz als Roh- und Werkstoff 21(5): 177-80.

The distribution of hot-water, ethanol/benzene and ether extractives in species including *Tectona grandis* is shown in tables.

4341 Narayanamurti, D; Verma, G.M. 1964. **Role of wood extractives in the rheological properties of wood**. Holzforschung und Holzverwertung 16(3): 51-55.

Investigated the effect of the content of extractives, the type of extraction, and the position in the stem, on the moduli of rigidity and elasticity, and damping capacity of the wood including teak.

4342 Narayanamurti, D; Verma, G.M. 1964. **The effect of wood extractives on enzymes of wood destroying fungi**. Holztechnologie 5(1): 33-40.

Hot-water, alcohol/benzene, ether and methanol extracts from species including *Tectona grandis* were tested in varying concentrations on extra-cellular enzymes of *Polystictus versicolor* and *Ganoderma lucidum*.

4343 Narayanamurti, D; Verma, G.M. 1964. **The role of wood extractives in the natural durability of wood**. Holzforschung und Holzverwertung 16(1): 1-13.

Sapwood and heartwood samples from different heights in the stems of species including *Tectona grandis* were extracted with hot water, alcohol/benzene, ether and methanol and then exposed to attack by various fungi after which their weight and strength were determined.

4344 Nearn, W.T. 1955. **Effect of water soluble extractives on the volumetric shrinkage and equilibrium moisture content of eleven tropical and domestic woods**. Bulletin of Pa. Agricultural Experimental Station 598 (Forestry School Series 2): 38p.

Determined the effect of extractions on the volumetric shrinkage of certain species that show an abnormally low volumetric shrinkage for their specific gravity. The species investigated include *Tectona grandis*.

4345 Newman, R.H; Hemmingson, J.A; Bayoumi, A.A.M.S. 1990 . **Determination of the degree of crystallinity in wood by carbon-13 nuclear magnetic resonance spectroscopy**. Holzforschung 44(5): 351-355.

A method for determining the degree of cellulose crystallinity exploits differences in proton rotating-frame relaxation time constants for cellulosic and non-cellulosic domains within samples of wood. A survey of woods from species taken have mean cellulose crystallinities of 0.54 for six hardwoods including *Tectona grandis*.

4346 Nilaubol, M.L.A; Siriaupotham, Ch. 1971. **Neutron activation analysis of gold in teak (*Tectona grandis*)**. (English; Thai). Proceedings of the Second Forestry Conference, Royal Forest Department R.129: 553-561.

The amount of gold in teak has been determined by using neutron activation technique. The spectrum of the energy peak of gold was identified a gamma multi-channel pulse height analyser. In teak especially Na, Ag, Cu, Mn, and La were interfering elements in the energy region. The variation is attributed to different environments in which teak grows.

4347 Nurhayati, T. 1999. **The properties of distillate obtained from destructive distillation of 4 wood species and their prospect for utilization as pesticide**. (Indonesian). Buletin Penelitian Hutan 17(3): 160-168.

Distillates obtained from destructive distillations of species including teak are all assumed utilizable as pesticide active components. Their utilization is based on their chemical constituent such as phenol, ethanol, acetic acid, etc. The study on the properties of the distillates covered physico-chemical and biological analyses on several pests and plant diseases.

4348 Panayotov, P; Stoyanov, D; Kjulanova, S. 2000 . **Determination of the quantity of flavonoids in plant extracts by UV-spectrophotometry**. Lesotekhnicheski Universitet. Yubileen sbornik nauchni dokladi: 75 godini visshe lesotekhnichesko obrazovanie v B"lgariya. Sektsiya Gorsko stopanstvo. 260-265. N. Pipkov; P. Zheler; I. Draganova, Eds. University of Forestry, Sofia, Bulgaria.

Wood extracts are essential for the resistance against wood-destroying fungi. These are mainly polynuclear compounds -- polyphenols. It has been found that they are mainly tannins and flavanols. This paper presents the results of an investigation on the quantities of flavonols contained in extracts of teak determined with the help of UV-spectrophotometry, with rutin being used as an indicator.

4349 Pandey, K.K; Upreti, N.K; Srinivasan, V.V. 1998. **A fluorescence spectroscopic study on wood**. Wood Science and Technology 32(4): 309-315.

Fluorescence spectroscopy has been suggested as an important tool for identification of timber. Investigations on the measurements of fluorescence excitation and emission spectra from solid wood blocks, powder and their extract in methanol from heartwood of species including *Tectona grandis* were made.

4350 Pavanaram, S.K; Row, L.R. 1957. **Chemical examination of *Tectona grandis* Linn.f.: Part 1 - Isolation of 3-hydroxy-2-methylanthraquinone**. Journal of Science and Industrial Research, India 16B(9): 409-411.

Three compounds were isolated from heartwood: Quinone, 2-methyl anthraquinone and a colourless neutral compound.

4351 Premrasme, T; Dietrichs, H.H. 1967. **Nature and distribution of extractives in teak (*Tectona grandis* Linn.f.) from Thailand**. Natural History Bulletin of the Siam Society 22(1/2): 14p.

The type, quantity and distribution of extractives in teak were examined in radial samples cut from cross-sections of teak trees from Thailand, by ethanol extraction and chromatographic spotting. The results help to explain such peculiarities as the lower quality of sapwood, the greater termite-resistance of stem- than of branchwood, the variable results of analyses for properties injurious to health, etc. The possibilities of control of timber quality and chemical properties in the cultivation of teak are briefly discussed.

4352 Purushotham, A; Tewari, M.C. 1958. **A note on the reduction of dichromates into**

chromates in timber. Journal of Timber Dryers' Preservation Association 9(1): 2-6.

Gives brief details of a systematic study of the mechanism of fixation of $Na_2Cr_2O_7$ and $K_2Cr_2O_7$ in wood based on impregnation of sawdust samples of species which include *Tectona grandis*. The main results showed that hexavalent chromium to trivalent chromium in case of teak was found to be about 18 percent.

4353 Ranganathan, S.K; Koshi, T; Sitaraman, N.L. 1949. **Methyl anthraquinone (tectoquinone)-a synergist for 2,2-bis (p-chlorophenyl)-1,1,1-trichloroethane (D.D.T.)**. Nature 164(4182): p1095.

Investigations have shown that it is possible to increase the potency of glass plates treated with DDT by storing them previously in a box made of Burma teak. Experiments showed that beta-methyl anthraquinone used against *Culex fatigans* did not kill but the addition of 5 percent by weight to DDT produced a striking increase over the kill of DDT.

4354 Romanis, R. 1887. **Certain products from teak**. Journal of Chemical Society 54: p868.

4355 Rudman, P. 1960. **Anthraquinones of teak (*Tectona grandis* Linn.f.)**. Chemistry and Industry 44: 1356-1357.

2-hydroxymethyl-anthraquinone, anthraquinone-2-carboxylic acid and anthraquinone-2-aldehyde were identified by paper chromatography following fractionation. The contribution of the anthraquinones to the colour change in freshly sawn teak or fresh sawdust is discussed.

4356 Rudman, P; Costa, E.W.B da. 1959. **Variation in extractive content and decay resistance in the heartwood of *Tectona grandis* Linn.f.** Journal of the Institute of Wood Science 3: 33-42.

The relationship between age, rate of growth, extractive content and decay resistance of teak heartwood has been studied. A significant degree of correlation has been demonstrated between decay resistance of teak heartwood and age, rate of growth and extractive content. Its natural decay resistance has been shown to be due to the presence of extractives.

4357 Sandermann, W; Braun, D; Augustin, H. 1965. **Unusual mineral inclusions in tropical woods**. (German). Report from Holz als Roh-und Werkstoff 23(3): 87-96.

Discusses chemical, X-ray and spectroscopic analyses of hard and soft inclusions in different species which include *Tectona grandis*. Some rare elements found are listed.

4358 Sandermann, W; Dietrichs, H.H. 1957. **Extraneous materials: The cause of wood peculiarities. Results of chromatographic analyses**. (German). Umschau, Frankfurt am Main 57(7): 197-200.

The investigation aimed at the isolation of active substances from the extractives of termite-resistant woods. A technique is described using cardboard which permits the isolation by elution of quantities sufficient for termite testing and further analysis. The content of tectoquinone in teak was greatest in the central heartwood. Tectoquinone content of teak from various regions corresponded well with the known termite-resistance ratings.

4359 Sandermann, W; Dietrichs, H.H. 1960. **Chemical studies of tropical woods. Part 4. Chemical investigation of teak wood**. Holzforschung 13(5): 137-148.

4360 Sandermann, W; Dietrichs, H.H; Simatupang, M.H; Puth, M. 1963. **Caout chouc containing woods**. Holzforschung 17(6): 161-168.

The method of extraction and identification by infra-red spectra was described. Teak is one of the species containing the caoutchouc in the parenchyma of xylem and also in heartwood. The hydrophobic properties of caoutchouc lend the wood certain technological properties and importance, showing high durability resistance to chemical attack and slow water absorption.

4361 Sandermann, W; Gerhardt, U; Weissmann, G. 1970. **Investigations on volatile organic acids in various wood species**. Holz als Roh-und Werkstoff 28(2): 59-67.

The amounts of volatile free fatty acids in woods of six species including teak were determined and the acids were analysed by gas chromatography. Varying amounts of formic, acetic and propionic acids and in some cases, butyric, crotonic and acrylic acids were produced. The importance of the free acids in influencing technical processes is discussed.

4362 Sandermann, W; Simatupang, M.H. 1961. **The chemistry of teak, an unusual wood**. (German). Chemiker-Zeitung, Kothen 85(2): 38-43.

Presents data on the chemical constituents of teak wood, their biogenesis and distribution over the stem cross-section, the connexion between the nature and amount of the constituents and the properties of the wood, the origin of Indonesian teak and analysis of teak wood from India and Java. The possibilities of impregnating ordinary woods with caoutchouc and quinone to make an artificial teak and selecting teak seed trees according to the results of chemical wood analysis of increment cores are pointed out.

4363 Sandermann, W; Simatupang, M.H. 1962. **A toxic quinone from teak wood**. (German). Angewantdtechem. 74(20): 782-783.

Certain teak logs which caused itching and eczema among workers in a German veneer mill were found to contain a substance identified as gamma-gamma-dimethylallyl-1,4 naphthoquinone.

4364 Sandermann, W; Simatupang, M.H. 1963. **Teak extractives. I. Isolation and constitution of a toxic teak quinone**. Chemische Berichte 96(8): 2182-2185.

Discusses constituents of teak wood and they differ in different localities. A new substance detected in a sample from India and a Javanese teak, which was identified as a naphthoquinone.

4365 Sandermann, W; Simatupang, M.H. 1963 . **The structure of the tectols and dehydrotectols in *Tectona grandis***. (German). Tetrahedron Letters, London 19: 1269-1272.

4366 Sandermann, W; Simatupang, M.H. 1965. **New quinones from *Tectona grandis***. (German). Naturwissenschaften 52(10): 262-263.

Three further quinones were found.

4367 Sandermann, W; Simatupang, M.H. 1966. **The chemistry and biochemistry of teak wood (*Tectona grandis*)**. (German). Holz als Roh-und Werkstoff 24(5): 190-204.

A compilation of information from world literature on the chemical constituents of teak wood, listing 41 compounds so far discovered, with their chemical formulae and literature references. Particular attention is paid to the quinones, terpenoid compounds, tectol and dehydrotectol, other naphthalene derivatives, fatty acids, the biogenesis of the compounds, the causes of the natural durability of the wood, contact eczemas and their causes, the technical importance of the compounds and the possibilities of chemical selection of mother trees.

4368 Sandermann, W; Simatupang, M.H. 1967. **Another biogenetically interesting compound from *Tectona grandis***. (German). Naturwissenschaften 54(5): p118.

Purification and examination of the oily neutral compound obtained from teak has led to the structural identification of the substance as 2, 2-dimethylnaphthochromane.

4369 Sandermann, W; Simatupang, M.H. 1978. **Chemistry and biochemistry of teakwood (*Tectona grandis* Linn.f.)**. Holz als Roh-und Werkstoff 24(5): 190-204. Institute of Paper Chemistry, Appleton, USA.

4370 Savard, J; Lecoche, D. 1968. **The action of wood on copper and aluminium**. (French). Bois et Forests des Tropiques 12O: 37-48.

A study of the action of aqueous extracts of eleven tropical hardwoods which include teak on Cu and Al. The corrosive potential of the wood extracts was much less on Cu than on Fe although the effects varied considerably between woods.

4371 Savard, J; Nicolle, J; Andre, A.M. 1959. **Chemical analysis of tropical woods. Vol. II**. Publication Centre Tech. For. Tropical 16: 250p.

Presents a detailed account of further studies on chemical analysis which include the application of paper chromatography to the analysis of wood and pulp, corrected cellulose by the Kurschner and Hoffer and the Seifert methods, determination of uronic acids, decarboxylation with 19 percent HCl, influence of xylans on decarboxylation, determination of functions of acids in bleached pulp, determination of holocellulose and of lignin.

4372 Schultz, K.H. 1962. **Sensitizing effect of the chemical components of tropical woods**. Berufsdermatosen 10: 17-37.

Acute contact eczema attributed to tectoquinone and lepachol found in wood dust of *Tectona grandis* is found to cause sensitizing effect.

4373 Schultz, K.H. 1965. **Allergic contact dermatitis due to tropic woods**. (German). Dermatology International 4(2): 121-124 .

A variety of woods, such as teak, from tropical and sub-tropical areas have been imported into Europe for use in the manufacture of furniture, ships, railroad cards, musical instruments, jewellery, knife handles and similar objects, which caused inflammatory manifestations of the skin and the mucosa of the respiratory system, the mouth and the digestive system as well as of the ocular tissue.

4374 Sekhar, A.C; Negi, D.D.S. 1955. **Studies on Izod values of some Indian timbers**. Indian Forest Bulletin 201 (Timber Mechanics) : p20.

The importance of Izod tests in timber including teak were discussed and various causes of variation have been pointed out and values given.

4375 Ser, C.S; Neo, S.L. 1982. **The susceptibility of some Malaysian timbers to iron stains**. Malaysian Forester 45(3): 425-430.

A test procedure using nails is described and results are reported for twenty seven species. Teak was found free from iron-tannate stain under damp conditions. No close correlation was found with wood chemical properties.

4376 Shah, R; Singh, T.C.N. 1944. **A preliminary note on the application of absorption-spectroscopy to timber wood extracts**. Current Science 13: 178-179.

Thin fine shavings of the woods of *Pterocarpus marsupium*, *Tectona grandis*, *Gmelina arborea* and *Boswellia serrata* were boiled separately in equal volumes of tap water for 15 minutes, subsequently cooled and filtered. These liquids were each subjected to spectroscopic examination and spectrograph of their absorption spectrum was taken in an arc light emitted from iron electrodes. The absorption spectra were shown to be very clear and characteristic for each species.

4377 Sharma, M. 1971. **A note on silica content in teak**. Journal of the Indian Academy of Wood Science 2(1): 25-26.

Analysis of samples of *Tectona grandis* from 23 localities in India and Burma showed that silica occurs only in the fibres and vessels, and is always of the vitreous type.

4378 Shinohara, T; Goto, T; Sakuno, T. 1967. **Studies on the wood gluing. II. Microscopic observation of glue line in tropical woods glued with phenol formaldehyde resin adhesive. (Preliminary report)**. (Japanese). Bulletin of Shimane Agriculture College 15A-2: 61-67.

Reports tests on eighteen species including teak.

4379 Simatupang, M.H. 1963. **Isolation and constitution of a toxic teak quinone**. Chemical Abstracts 59 No. 11366b.

A toxic quinone was isolated from various health damaging teak varieties and identified by degradation and synthesis as 2-(3, 3-di-methylallyl), 1, 4-naphthoquinone.

4380 Simatupang, M.H. 1964. **Chemical investigation of teak wood**. Dissertation, University of Hamburg, West Germany.

4381 Simatupang, M.H. 2003. **Deoxylapachol, the allergenic agent in teak, a potential threat?** International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

The less desirable properties of teak are inhibition the hardening of lacquers based on radical polymerization, occurrence of calcium phosphate inclusions and inducing dermatitis and allergenic reactions. The cause and occurrence of these health injurious effects are reviewed.

4382 Simatupang, M.H; Rosamah, E. 1996. **Importance of teakwood extractives to wood properties and tree breeding**. Forestry and forest products research: Proceedings of the Third Conference, Kepong, 3-4 October 1995, Volume 2: 235-246. K. Yamamoto; A.M. Abdul Rashid; Abdul Rahim Nik; A. Mohamad; Lee Su See; Wong Han Hoy; Khoo Kean Choon, Eds. Forest Research Institute Malaysia, Kuala Lumpur.

The wood is of medium density, has very good dimensional stability, prevents iron nails from rusting, is rather resistant against chemicals, and has a high natural durability against wood destroying fungi and termites. The termiticidal properties are due to anthraquinones. Caoutchouc is the most abundant occurring compound in teakwood. The compound is responsible for the water repellent properties of the wood. The synergistic effect of active and non-active wood extractives is the cause of the durability against wood destroying fungi. A new antioxidant was recently isolated from the acetone extract of teakwood and this compound protects against oxidation and rusting of iron nails.

4383 Simatupang, M.H; Yamamoto, K. 2000. **Properties of teakwood (*Tectona grandis***

Linn.f.) and mahogany (*Swietenia macrophylla* King) from manmade forest and influence on utilization. Proceedings of the seminar on high value timber species for plantation establishment - teak and mahoganies, Sabah, Malaysia, 1-2 December 1998. H.H. Chan; K. Matsumoto, Eds. JIRCAS-Working-Report 16: 103-114.

The wood and timber properties of teak and mahogany, especially those influenced by wood extractives, are briefly reviewed, because the advantageous as well as the less desirable characteristics are mostly due to these compounds.

4384 Singh, P; Jain, S; Bhargava, S. 1989. **A 1,4-anthraquinone derivative from *Tectona grandis***. Phytochemistry 28(4): 1258-1259.

4385 Venkateswara Rao, D; Narayan Nambiyar, V.P. 1946. **Light-scattering in aqueous timber wood extracts**. Current Science 15(1): 19-20.

A study of the factors of depolarisation of the light transversely scattered in aqueous timber wood extracts is capable of yielding reproducible and characteristic values for each specimen and would also throw valuable light on the state of dispersion in the medium of the scattering elements. The results of investigation are given and show that the method of light scattering in aqueous timber wood extracts can be relied upon for the identification of timbers.

4386 Vermeer, D.J.M; Dejong, J.C; Lenstra, J.B. 1949. **Occupational eczema through teak wood**. Netherlands Tijdschr. Geneesu 93: 2338-2344.

Five persons hypersensitive to peroba teak wood who got occupational eczema are described.

4387 Wise, L.E; Rittenhouse, R.C; Dickey, E.E; Olson, O.H; Garcia, C. 1952. **The chemical composition of tropical woods**. Journal of Forest Products Research Society 2(5): 237-249.

Teak along with other woods were subjected to qualitative and quantitative analysis.

4388 Yatagai, M. 1999. **Components of tropical trees and their utilization (8) Physiologically active substances**. Tropical Forestry 45: 50-55.

An account is given of physiologically active substances derived from a variety of tropical tree species including *Tectona grandis*.

4389 Yonenobu, H; Kikata, Y; Morishita, F; Hattori, Y; Marsoem, S.N. 1994. **14C concentrations in tree stems II**. Journal of the Japan Wood Research Society 40(6): 627-630.

Concentrations of 14C were measured in stems of teak from Java and Indonesia along with other species. Statistical analysis showed that there is no significant difference in trees of the same species. Latitude had an effect on 14C concentration.

Go top

Wood Working Properties

4390 **Mysore teak: Extract from Indian engineering**. Indian Forester 16, 1890: p248.

Compares Mysore and Malabar teak woods with that of Rangoon and recommends use of Mysore wood for ship building.

4391 **Belt sanding of beech, oak, teak and palisander (*Dalbergia* spp.)**. Tree Industrien 16(6), 1966: 86-89.

Makes recommendations for each species on method and grade of abrasive to give a satisfactory surface.

4392 **Hardwoods for joinery and construction: Test results and recommendations**. BRE Digest 431, 1998: 16p. Building Research Establishment, Watford, UK.

Results are presented for tests of wood properties, durability and sawing and woodworking characteristics for different hardwoods including *Tectona grandis*.

4393 Ayarkwa, J; Addae Mensah, A. 1999. **Processing of small diameter logs: Effect of log diameter, sawing pattern and some bole variables on lumber recovery**. Ghana Journal of Forestry 8: 43-51.

The effect of log diameter, sawing pattern, log length and log stem form on lumber yield have been studied with a view to finding the most efficient processing technique for small diameter plantation grown teak logs in Ghana. The study has shown that there are significant differences between lumber yields from log diameter classes 10-20, 21-30 and 31-40 cm, and that larger log diameters generate higher lumber yields than smaller log diameters. The results of the study indicate that small diameter plantation grown logs of 30 cm diameter can be efficiently processed to give improved yields, if suitable sawing methods are adopted.

4394 Bhat, K.M. 1999. **Need for technology transfer to producer countries for processing small dimensional timbers of teak plantations**. Proceedings of the 14th International Wood Machining Seminar, Paris, 12-19 September 1999: 281-290.

The current level of technology for sawing, veneer and glulam composite product manufacture from small dimensional timbers of teak plantations in developing countries particularly India is examined. There is a need for technology transfer to increase the level of technology in mechanical wood industries that allows the use of smaller and younger trees.

4395 Butterwick, A.J. 1917. **Stray notes the working of teak in Burma**. Indian Forester 48(11/12): 488-498.

Discusses the details of the operations for efficient working and regeneration of teak forests in Burma.

4396 Chelvarajan, B.K. 1957. **Nail holding power of a few Mysore woods on a mohr-and Federhaff Universal testing machine**. Indian Forester 83(4): 260-264.

Gives nail holding power of thirty four species of woods including teak. Oily-woods like teak, sandal, etc. have lower values compared with woods of similar specific gravity.

4397 Chugg, W.A; Wood, T; James, P.E. 1965. **The gluability of hardwoods for structural purposes**. Timber Research Development Association, London, Research Report E/RR/22: 18p.

An investigation of the gluability of nineteen hardwoods including teak is made to determine their suitability for use in glued timber components.

4398 Endom, W; Mammen, M. 1991. **Problem of log split in teak forest operation**. Forest Products Research Journal 9(3): p3.

4399 Goto, T; Sakuno, T; Onishi, H. 1967. **Studies on the wood gluing. I. On the gluability of tropical woods (Part 1)**. (Japanese). Bulletin of Shimane Agriculture College 15A-2: 53-60.

Presents the results of tests on woods including *Tectona grandis*.

4400 Hansen, W. 1964. **Wood finishes in furniture**. Wood 29(12): 50-52.

Describes recent development in Denmark and Sweden, particularly teak which is treated with either a quick-drying oil, special acid-hardening teak lacquer or thin polyurethane lacquer and machine or hand sanded. The best appearance is given by quick drying oil.

4401 Hon, L.Y; Lopez, D.T. 1968. **Machining properties of some Malayan timbers**. Malaysian Forester 31(3): 194-210.

Describes briefly the tools and machines used for determining four machining properties of timbers viz. sawing, planing, boring and turning. Teak is one of the test materials included in the study.

4402 Hwang, G.S. 1985. **Bonding test of wood at high moisture content**. (Chinese). Taiwan Forestry Research Institute, Bulletin 447: 10p.

Woods of different species including *Tectona grandis* were glued using resorcinol, polyurethane or epoxy resins at 12, 30 or 60 percent moisture content.

4403 Kamil, R.N. 1970. **Prefabricated houses and prospects of their development in Indonesia**. (Indonesian). Pengumuman, Lembaga Lembaga, Penelitian Kehutanan 97: 138p.

Gives a detailed account of the technology of prefabricated house construction, especially with wood-based materials and describes a system developed at the Forest Products Research Institute, Bogor. A roofing panel consisting of 25 *Tectona grandis* shingles is developed. Proposals are made for setting up a prefabricated-house factory in Java.

4404 Kanazawa, H. 1978. **Inhibition of adhesion with tropical woods: The case of teak wood**. (Japanese). Tropical Forestry 49: 15-19.

4405 Lalitha, H.C; Victor, V.J. 1971. **A method for the measurement of adhesion tension of liquids in contact with wood**. Journal of the Indian Academy of Wood Science 2(2): 84-88.

Describes an apparatus for measuring the rate of capillary penetration into wood specimens including *Tectona grandis* and shows how the data may be used to calculate adhesion tensions between the liquids and these species.

4406 Limaye, V.D. 1946. **Safe working stresses of Indian timbers (cf. *Tectona grandis*)**. Indian Forest Records (n.s.) Utilization 4(1).

4407 Mottonen, V; Asikainen, A; Malvaranta, P; Oykkonen, M. 2003. **Peroxide bleaching of parquet blocks and glue lams**. Holzforschung 57(1): 75-80.

A method of bleaching of wood in the wood working industry, using hydrogen peroxide solution was investigated. In this method, the lightness could be increased of all the wood species tested. In the case of teak, the redness could be increased markedly.

4408 Munz, W. 1959. **The surface treatment of teak furniture**. (German). Holztechnik 30(10): 37-38.

Discusses the mechanical preparation of the surface, and the oiling of the wood.

4409 Narayanamurti, D; Singh, K. 1962. **Sanding qualities of Indian timber: Preliminary investigation**. Paintindia 12(2): 23-24.

Describes preliminary results of sanding qualities of some Indian timbers including *Tectona grandis*. Tests were done on teak samples of different rubber content. The results indicate that the wear resistance increases with coutchouc content and higher the coutchouc content the smoother the surface.

4410 Pandey, C.N; Joshi, N; Swaroop, C. 2002. **Embossing on wood - an alternative technique to wood carving**. Journal of the Timber Development Association of India 48(3/4): 24-26.

The embossing behaviour of different species includes *Tectona grandis* after plasticization with vapour phase ammonia was evaluated to determine the optimum treatment periods, the ammonia absorption and minimum pressing pressure and time required to produce clear impression on the surface of the wood.

4411 Pandey, C.N; Rao, P.V.K. 1995. **Wood softening and bending with ammonia**. Wood News 5(1): 29-31.

The woods of six commercially important Indian timber species including teak gave satisfactory bends of radius 100-175 mm in 13 and 25-mm-thick strips when plasticized with ammonia at 5 kg/cm2 pressure.

4412 Patil, Y.P; Gajre, B; Dusane, D; Chavan, S; Mischra, S. 2000. **Effect of maleic anhydride treatment on steam and water absorption of wood polymer composites prepared from wheat straw, cane bagasse, and teak wood sawdust using novolac as matrix**. Journal of Applied Polymer Science 77(13): 2963-2967.

4413 Raknes, E. 1969. **The gluing of teak**. FIRA Transl. Furn. Indian Research Association Stevenage 12, Transl. from Medd. Norak Tretekn Institute 19.

A study of the gluability of teak with various adhesives. Caesin glue gave poor results, but all the other glues gave excellent results provided that the gluing pressure was 2 kg/sq.cm.

4414 Rawat, B.S; Rajput, S.S; Pant, B.C. 1972. **A note on the working qualities of some Indian timbers**. Indian Forester 98(11): 669-676.

Describes test conditions for four woodworking operations like planing, boring, mortising and turning and tabulates and evaluates the behaviour in each test of *Tectona grandis* and other species with information on the incidence of defects.

4415 Reinsch, H.H. 1963. **Painting and repainting teak**. (German). Industrie Lackier Betrieb, Hannover 31: 77-78.

Recommends cleaning exuding extractives from the surface with a solvent, and the use of a suitable primer, on an alkyd or polyurethane basis.

4416 Sastrodimedjo, S; Widodo, A.C; Sumantri, I. 1974. **Relation between the wear on hand saws and the cross-section of *Tectona grandis* logs**. (Indonesian). Laporan, Lembaga Penelitian Hasil Hutan 4: 3p.

The daily wear on the saws showed a positive linear regression on the total cross-section that was cross-cut per day, but the latter accounted for only 16 percent of the variation in the wear.

4417 Seetharamu, L; Victor, V.J; George, J. 1974. **Resistance to sustained load of polyvinyl acetate dispersion-based adhesives. Part II**. IPIRI Journal 4(2): 81-83.

The change of failing load with time of double lap joints of teak slips glued with PVA adhesive was determined. The limit of sustained loading for at least seven days under the conditions of the test was established.

4418 Sekhar, A.C. 1955. **Working qualities of some Indian timbers**. Indian Forester 81(11): 724-732.

Describes the methods employed at the Forest Research institute, Dehra Dun, to determine working and finishing qualities of wood and gives the working qualities determined for timbers including teak.

4419 Sekhar, A.C; Gulati, A.S. 1972. **Suitability indices of Indian timbers for industrial and engineering uses**. Indian Forest Records, Timber Mechanics 2(1): 1-62.

Methods of evaluation for constructing suitability indices are surveyed, and indices of suitability for industrial and engineering purposes are presented for species including teak.

4420 Sekhar, A.C; Rana, R.S. 1956. **Nail and screw holding power of Indian timbers**. Indian Forest Records (Timber Mechanics) 1(5): 109-122.

Teak is one of the many species on which work done has been reported.

4421 Shukla, K.S; Gupta, S.B. 1983. **Finishing qualities of some Indian woods**. Indian Forester 109(2): 80-90.

Specimens of forty nine Indian timbers including teak were given five different surface filling treatments after initial sanding and before a final sanding and application of shellac varnish. Data are tabulated for each species showing general properties and percentage of gloss developed after each treatment. Treatments tested were two coats of shellac varnish, chalk powder paste, linseed oil, paste of animal glue and chalk powder, or paste of chalk powder followed by a coat of copal varnish.

4422 Shukla, K.S; Pandey, K.N; Pant, B.C; Badoni, S.P. 1990. **Carving behaviour of some Indian timbers - a quantitative approach**. Journal of the Indian Academy of Wood Science 21(2): 27-32.

Carving behaviour of timbers including *Tectona grandis* is studied and the results are presented.

4423 Shukla, N.K; Singh, K.R. 1987. **Nail and screw holding power of Indian timbers**. Journal of the Indian Academy of Wood Science 18(2): 57-68.

A review of work at the Indian Forest Research Institute, reporting and discussing the results of tests on 50 Indian timbers under different conditions. Composite nail/screw holding power and suitability indices with respect to teak as 100 is reported.

4424 Shyamasundar, K; Victor, V.J. 1972. **Nail holding power of plywood. Part II. Nail holding power of wood, plywood, particle board and hardboard**. IPIRI Journal 2(3/4): 94-99.

The nail-holding powers of solid wood, teak, plywood, particle board and oil-tempered hardboard were compared. At similar thickness, the nail-holding power of plywood is nearly twice that of the other materials.

4425 Singh, S.M. 1973. **The painting of wood**. Paintindia 23: 16-21.

The species judged to have good paint holding properties were *Dalbergia sissoo* and *Tectona grandis*.

4426 Sobukawa, T; Kanazawa, H. 1977. **Studies on the gluing of the wood articles. X. Gluing of the furniture parts with new adhesives**. (Japanese). Mokuzai Kogyo Wood Industry 32(10): 14-18.

In bonding tests with uncoated teak, good bondability was obtained with aqueous vinyl urethane resin (VUR) and resorcinol resin adhesives. The bond strength of teak bonded with VUR was increased by increasing the volume of crosslinking agent in the adhesive.

4427 Stefanov, B; Naidenova, T.S. 1975. **Some tree species from Vietnam having wood valuable for the Bulgarian woodworking industry**. (Bulgarian). Gorsko Stopanstvo 31(10/11): 39-43.

Gives brief notes on the wood of thirty nine species of N. Vietnamese hardwoods of interest for Bulgaria including teak, especially in the furniture industry.

4428 Takenami, K. 1964. **Studies on the discoloration of wood. (I) Sensitivities of various wood species for the dyeing effect with iron, and (II) with copper and chrome**. Journal of Japanese Wood Research Society 10(1): 22-35.

Tabulates data for five softwood and eleven hardwood species, heartwood and sapwood veneers of which were soaked in a one percent Fe solution or in distilled water before being pressed against an Iron plate.

4429 Wang, S.Y. 1981. **Studies on the dimensional stability and durability of the coated surface of some woods for furniture**. Experimental Forest, National Taiwan University, Technical Bulletin 128: 40p.

Five timber species were impregnated with PEG solutions of varying concentration, viz. *Anisoptera, Tectona grandis, Acacia confusa, Intsia* and *Sindora*. One group of specimens was tested under desorption conditions and absorption conditions for dimensional stability.

Go top

Thermal Properties

4430 **Good fuel wood**. Indian Forester 74(7), 1948: p279.

Teak with a calorific value of 4909 to 5042 is considered as a good fuel wood.

4431 Chembukulam, S.K; Dandge, A.S; Kovilur, N.L; Seshagiri, R.K; Vaidyeswaran, R. 1981. **Smokeless fuel from carbonized sawdust**. Industrial and Engineering Chemistry, Product Research and Development 20(4): 714-719.

Studied carbonization of teak sawdust in detail. The temperature required for producing a char suitable for use as a smokeless domestic fuel was 538 degree C.

4432 Dubey, Y.M; Jain, J.D; Gupta, S. 1999. **Studies on thermal conductivity of some Indian hardwoods**. Journal of the Timber Development Association of India 45(1/2): 33-38.

Thermal conductivity of eleven Indian wood species including teak along the tangential direction in oven-dry condition at four different mean temperatures were determined and a relationship between thermal conductivity and specific gravity and temperature has been established.

4433 Fuwape, J.A. 1993. **Charcoal and fuel value of agroforestry tree crops**. Agroforestry Systems 22(3): 175-179.

Charcoal was produced from eighteen samples of short rotation trees including *Tectona grandis* from an agroforestry plantation at the Federal University of Technology at Akure, Nigeria. Combustion related properties were determined in wood and charcoal of each species. The gross heat of combustion of wood and charcoal was also determined.

4434 Jentzsch, H. 1952. **Determination of the ignition and combustion properties of wood and other substances using the author's ignition method**. Holz als Roh-und Werkstoff 10(10): 385-390.

The method and details of test were described.

4435 Kandya, A.K. 1982. **Caloric content and energy dynamics in six tropical dry deciduous forest tree species**. Indian Journal of Forestry 5(3): 192-195.

Calorific content of various plant parts was determined. Data are tabulated showing calorific content in different parts and energy contents at time of harvest for *Tectona grandis* and other species.

4436 Keylwerth, R; Christoph, N. 1963. **Basic investigations of the thermal decomposition and ignition of wood**. Mitt. Dcut. Ges Holzforsch 50: 125-137.

Thermal analysis of blocks of untreated and fire proofed wood were carried out. Pyrolysis gas chromatograms of untreated and fire-proofed teak are given.

4437 Komarayati, S; Gusmailina; Hendra, D. 1997. **Manufacturing of activated charcoal from teakwood sawdust**. Buletin Penelitian Hutan 15(2): 94-100.

Studied the quality of activated charcoal from teak sawdust and the water quality after treatment with the activated charcoal.

4438 Krishna, S; Ramaswamy, S. 1931. **A note on the variation in the calorific values of sapwood and heartwood of some of the Indian fuel woods**. Indian Forester 57(3): 110-117.

Data is presented of the calorific values of some of the fuelwoods including teak. When organic deposits were removed from heart wood, calorific value is correspondingly lowered in the case of teak and value of heart wood for all species is generally far more than sapwood.

4439 Krishna, S; Ramaswamy, S. 1932. **Calorific value of some Indian woods**. Indian Forest Bulletin 79.

Calorific value of completely dried and ash free teak wood is 4,989 cal. for sapwood and 5535 cal. for heartwood.

4440 Pandey, C.N; Kamala, B.S; Jain, J.C. 1981. **Thermal conductivity of some wood species of Karnataka**. Journal of the Indian Academy of Wood Science 12(1): 23-25.

A linear relation was found between the thermal conductivity and density of specimens of teak and other species.

4441 Pandit, B.R; Jana, C.K. 2001. **Energy content and its calorific values of *Tectona grandis* in Dangs forest ecosystem**. Advances in Plant Sciences 14(1): 53-56.

The calorific values in the different parts of *Tectona grandis* was analysed by Bomb calorimeter. The highest calorific values and lowest were observed in branches during winter season and summer season respectively.

4442 Rao, T.L.N; Datar, D.S. 1954. **Activated charcoal from teak wood sawdust**. Proceedings of Indian Science Congress Association 41: p108.

4443 Rao, T.L.N; Datar, D.S. 1957. **Activated charcoal from groundnut hull. Part III Comparative study of activated carbon from groundnut hull and teakwood sawdust**. Journal of the Indian Chemical Society 20(2): 75-81.

Comparative studies have been made using zinc and ferrus chlorides as activators and effect of washing the carbons with alkali solutions.

4444 Rierink, A. 1938. **On the calorific values of 60 Netherlands - Indian wood species**. Korte Meded Boschbouw Proefsta 62; Tectona 31(6): 400-418.

Teak and conifers are reported to have high calorific value. No relation is found between calorific value of sapwood or heartwood but heartwood generally has slightly high calorific value and these values are compared for Java, Burma and Siam teak .

4445 Shida, S; Shibusawa, T; Hukushima, Y. 1991. **Utilization and evaluation of exterior wood II. Sensory warmth of the deck materials**. Journal of the Japan Wood Research Society 37(12): 1123-1128.

The sensory warmth of a foamed plastic and six wood species including teak used in exterior decks was estimated at 60 degree C and its relation to thermal conductivity, surface temperature and specific gravity was determined.

4446 Singh, P. 1911. **Note on calorimetric tests of some Indian woods**. Indian Forest Bulletin 1.

Gives air dry and calorific power of plantation grown and natural grown teak of Burma.

4447 Steinbeck, K; Wijesinghe, M.T.J.P. 1982. **Calorific values of twelve forest tree species growing in Sri Lanka**. Sri Lanka Forester 15(3/4): 136-138.

Calorific values were determined of twelve species including teak.

4448 Sylviani; Widiarti, A. 2001. **Determination of superior species for fuelwood**. Journal Sosial Ekonomi 2(2): 139-150.

Go top

Natural Durability

(See also 0590, 0924, 3056, 3068, 4101, 4537)

4449 **Planted v/s natural teak**. Indian Forester 7, 1882: 256-257.

A general discussion on the durability of naturally grown teak timber as compared with that of plantation origin.

4450 **Durability of teak**. Indian Forester 50(6), 1924: p339.

Reports tests on transverse strength of teak wood of 370 years old from Bijapur remain normal. Teak beams of 6th century of Ctesiphon are reported undecayed and teak ribs at Buddhist Daliya and Karli date back to B.C.

4451 **Durability of heartwood**. Report of Forest Products, Australia 1960/61, 1961: 19p.

Tests showed that the termite resistance of teak heartwood, is largely due to anthrones and anthra quinones containing a beta carbon side chain. Decay resistance is associated with a neutral extractive.

4452 **Natural durability of teak**. Report of Forest Products, Australia 1964/65, 1965: p39.

Tests of decay resistance on samples from 21 *Tectona grandis* seed trees in a teak breeding programme in Papua-New Guinea have shown a wide variation in size of non-durable core.

4453 Abdurachim, M.R.A. 1960. **Stake test in Indonesia-I**. Forest Research Institute, Bogor, Special Communication 15: 19p.

4454 Abdurachim, M.R.A. 1965. **The influence of tree age on the durability of teak (*Tectona grandis*)**. Laporan, Lembaga Penelition, Kehutanan, Bogor 98: 12p.

Results of graveyard tests show that durability increases with increasing age. Decay was responsible for the damage to 81 percent of the specimens and termites or termites plus decay for the rest. The relation of resistance to extractive content is discussed.

4455 Ahmad, M. 1991. **Natural resistance in teak clones to leaf skeletoniser, *Eutectona***

***machaeralis* (Lepidoptera: Pyralidae) in south India**. Indian Journal of Forestry 14(3): 228-231.

Twenty clones of teak were evaluated for their relative natural resistance against the leaf skeletonizer, *Eutectona machaeralis*, in a clonal orchard in Kerala. In most of the resistant clones the leaves were harder with smoother surfaces.

4456 Arndt, U; Willeitner, H. 1969. **On the resistance behaviour of wood in natural weathering**. Holz als Roh-und Werkstoff 27(5): 179-188.

Weathering caused weight losses up to 10 percent and also changes in colour and in odour.

4457 Bakshi, B.K (et al). 1961. **A note on decay resistance of teak, shisham and khair**. Indian Forester 87(1): 40-41.

Samples of three species including teak were tested with agar cultures of four different fungi. *Tectona grandis* was found to be moderately resistant. The outer heartwood was relatively more decay-resistant than the inner in teak.

4458 Bakshi, B.K; Puri, Y.N; Singh, S. 1967. **Natural decay resistance of Indian timbers. I. Introduction and method. II. Decay resistance of sal (*Shorea robusta* Gaertn.) and teak (*Tectona grandis* Linn.f.)**. Indian Forester 93(5): 305-328.

Soil block methods for evaluation of natural decay resistance of timber under laboratory conditions are described in detail. Decay resistance was tested on samples of teak from outer and inner heartwood regions on the same radius. Variations in decay resistance appear to be correlated with age of trees, rate of growth and radial position of heartwood in the logs.

4459 Barnes, A.H. 1940. **Fallacies about fire resistance**. Wood 5: 267-269.

Results from a test of the relative combustibility of certain timbers including teak are presented.

4460 Bavendamm, W; Anuwongse, B. 1967. **On the decay resistance of wood species from Thailand**. (German). Holz als Roh-und Werkstoff 25(10): 392-393.

Kolle-flask tests were carried out on species including *Tectona grandis* for decay resistance. The test fungi were *Coniophora cerebella*, *Polystictus versicolor* and *Daedalea quercina*.

4461 Becker, G. 1961. **Testing and assessing the natural termite resistance of wood**. (German). Holz als Roh-und Werkstoff 19(7): 278-290.

Investigations were made on the natural resistance of the sapwood and heartwood of fourteen tropical hardwoods including teak from Indonesia. Teak is the most resistant Indonesian test species.

4462 Bhat, K.M; Florence, E.J.M. 2003. **Natural decay resistance of juvenile teak wood grown in high input plantations**. Holzforschung 57(5): 453-455.

A study is made to evaluate the natural decay resistance of five year old juvenile teak wood grown in a fertilised and irrigated stand based on accelerated laboratory testing against two white rot fungi. It is found that juvenile wood from high input plantations is less decay resistant than the wood of 13 year old trees and mature teak wood of forest plantations.

4463 Brandis, D. 1882. **Extraordinary durability of teak**. Indian Forester 7: p260.

Gives an account of teak plants used in Vithal Raj Swami temple in old city of Vijayanagar, Mysore which are now more than 500 years old without any signs of decay of wood.

4464 Brascamp, E.H.B. 1915. **Examination of the durability of teak wood**. Tectona 8: p160.

4465 Brooks, R.L; Adamson, A.M; Baker, R.E.D; Crowdy, S.H. 1941. **Durability tests on untreated timbers in Trinidad**. Caribbean Forester 2: 101-119.

In the graveyard tests, it is found that fungus attack was more responsible for damage than termites. There was a fairly close correlation between the relative susceptibilities of the various timbers to termite and fungal attack.

4466 Chaudhry, M.I; Malik, N.K; Arshad, M. 1978. **Natural resistance of various timbers to the attack of *Coptotermes heimi* (Wasm)**. Pakistan Journal of Forestry 28(2): 123-126.

Twelve common timber trees of Pakistan were tested for their resistance to *Coptotermes heimi*. Based on the longevity of workers and soldiers released on sawdust of these timbers, *Cedrus deodara* and *Tectona grandis* proved the most resistant species.

4467 Cheriyan, P.V; Cheriyan, C.J. 1978. **Observations on the natural durability of fifteen**

species of Indian timbers in Cochin harbour waters. Journal of the Timber Development Association of India 24(1): 25-29.

Three pieces of heartwood of each of fifteen species were suspended in iron frames below low tide. They were examined for durability after a period. Teak was found moderately long lived.

4468 Cheriyan, P.V; Cheriyan, C.J. 1980. **A report on the durability of some common Indian timbers treated with creosote: Fuel oil in Cochin harbour waters**. Indian Forester 106(6): 413-417.

Fifteen provenances of twelve species of timber including teak were treated with a 50:50 mixture of creosote: fuel oil and tested for durability. Most species showed resistance to borers especially teak, *Dipterocarpus indicus* and *Xylia xylocarpa*.

4469 Chung, D.H; Chen, S.S. 1983. **A study on the electrical resistance property in wood**. Forest Products Industries 2(3): 45-52.

The electrical resistance of wood from twelve species including *Tectona grandis* was measured and found to be linearly related to moisture content, with resistance decreasing as moisture content increased.

4470 Costa, E.W.B da; Rudman, P; Gay, F.J. 1958. **Investigations on the durability of *Tectona grandis***. Empire Forestry Review 37(3): 291-298.

Laboratory tests were made of resistance to decay and termite attack and extractive content of eighteen natural and plantation grown teak trees. Teak sapwood samples were less resistant than the heartwood. Investigations are made of reasons for this difference, as well as studies of the nature and toxicity of extractive materials in teak.

4471 Costa, E.W.B da; Rudman, P; Gay, F.J. 1960. **Relationship of growth factors to durability of teak**. FAO Teak Sub-Commission, New Delhi FAO/TSC 60: 12P.

Detailed study of durability of teak from sixteen trees of ages 14-180 years old were selected and tested against decay resistance. It is indicated that high growth rate is associated with low durability. The growth factors tested include distance from zone of pith, number of growth rings from pith, age of tree at felling, rate of growth sample zone and time elapsed since zone was transferred to heartwood.

4472 Costa, E.W.B da; Rudman, P; Gay, F.J. 1961. **Relationship of growth rate and related factors to durability in *Tectona grandis***. Empire Forestry Review 40(4): 308-319 [Pakistan Journal of Forestry 13(2), 1963: 216-220].

In a detailed study of radial variation in durability of teak wood and its relationship to growth factors, 16 trees, 14-180 years old, were selected and 1-13 heartwood zones from each tree were tested for resistance to decay by *Coniophora olivacea* and *Coriolus versicolor* by a sawdust decay technique.

4473 Dai, Z.R; Xie, X.Y; Huang, Z.Y. 1985. **Natural resistance of 22 timber species to *Coptotermes formosanus* Shiraki in a laboratory test**. Acta Entomologica Sinica 28(2): 238-240.

The natural resistance of the timber of twenty two tree species to the termite *Coptotermes formosanus* was determined in laboratory tests in Guangdong Province, China. The results showed that the most resistant species include *Tectona grandis*.

4474 Das, N.R; Chandola, L.P; Ramola, R.C. 1965. **Data on the natural durability of timber species**. Journal of Timber Development Association, India 11(2): 6-12.

Durability of *Tectona grandis* in Madhya Pradesh is reported. Heartwood of this timber is very refractory to treatment.

4475 Don Pedro, K.N. 1983. **Natural resistance of some Nigerian timber species to *Amitermes evuncifer* Silvestri (Isoptera)**. Revue de Zoologie Africaine 97(3): 647-652.

The natural resistance of four timber species in Nigeria to attack by *Amitermes evuncifer* was tested in the laboratory under choice and forced-feeding conditions and teak is found resistant to termite attack.

4476 Edwardes, S.M. 1923. **A note on the durability of Indian teak**. Indian Forester 49(3): 165-168.

Quoted instances of using teakwood for over 2,000 years and recommends use of teak for ship-building as exceptionally most suitable wood.

4477 Forest Products Research Laboratory, Australia. 1944. **Termite-proofing of timber for use in the tropics**. Forest Products Research Laboratory, Australia, Leaflet 38: 6p.

A brief account of the types and general habits of termites is given and discusses the proper construction of buildings in termite-infested areas, use of soil poisons, preservative treatment of timber, plywood and fibre or composition boards and the use of termite resistant woods.

4478 Gambetta, A; Orlandi, E. 1978. **Natural durability of some tropical woods to marine borers in the Tyrrhenian Sea**. (Italian). Contributi Scientifico Pratici per una Migliore Conoscenza ed Utilizzazione del Legno 22: 9-17.

The marine borer resistance of eighteen tropical woods including *Tectona grandis* was tested by exposure to marine borers. *Tectona grandis* is found moderately resistant.

4479 Grace, J.K; Yamamoto, R.T. 1994. **Natural resistance of Alaska-cedar, redwood, and teak to Formosan subterranean termites**. Forest Products Journal 44(3): 41-45.

The relative susceptibility of the species to Formosan subterranean termite, *Coptotermes formosanus* was evaluated in laboratory tests. The results indicated that these naturally durable woods compared favourably in termite resistance with preservative treated woods.

4480 Grohs, B.M; Kunz, B. 1998. **Study on the development of a potential biological wood preservative against mould growth with heartwood extracts as an example**. Holz als Roh-und Werkstoff 56(4): 217-220.

The antifungal activity of the heartwoods of different trees including teak against wood inhabiting moulds was tested. Beside the heartwoods their organic extracts exhibited antifungal effects.

4481 Hardy, E. 1942. **Woods for dye vats and chemical storage**. Text. Record 60(711): 35-37.

Teak is found resistant to alkalis. Factors affecting the resistance of wood to corrosive chemicals are discussed briefly.

4482 Jackson, W.F. 1955. **Natural durability of Java teak sleepers**. Malaysian Forester 8(3): 159-160.

Data on the durability of Java teak sleepers laid on Malayan Railways are tabulated with comparative data on *Balanocarpus heimii* sleepers. Teak proved markedly inferior to Chengal.

4483 Jain, A; Roychoudhury, N; Sharma, S; Bhargava, A; Pant, N.C. 1998. **Host plant resistance to insect pests in teak (*Tectona grandis* Linn.f.) with reference to biochemical parameters**. Indian Journal of Forestry 21(4): 285-289.

The teak leaf skeletonizer, *Eutectona machaeralis* and the teak defoliator, *Hyblaea puera* are the key insect pests of *Tectona grandis* in India, causing severe epidemic defoliation in all teak growing areas. Some clones of teak from ten Indian states growing at the National Teak Germ Plasm Bank, Maharashtra were evaluated for natural resistance against these pests. Foliar phosphorus, calcium and magnesium content were found significantly higher in the most resistant clone and lowest in the most susceptible clone.

4484 Jain, A; Roychoudhury, N; Bhargava, A. 2000. **Role of foliar protein and polyphenol and their relationship to clonal resistance in teak against the leaf skeletoniser, *Paliga machaeralis* Walker (Lepidoptera: Pyralidae)**. Journal of Tropical Forest Science 12(2): 221-226.

Leaf protein and polyphenol contents were estimated for selected resistant and susceptible clones of teak to the leaf skeletoniser, *Paliga machaeralis*. The protein and polyphenol contents of clonal leaves were proportional to the amount of leaf damage. A low ratio indicated higher resistance and vice versa.

4485 Jain, A; Singh, A.K; Banerjee, S.K; Shukla, P.K. 2002. **Chemical screening of different clones of *Tectona grandis* in relation to resistance against their key defoliators**. Indian Journal of Forestry 25(3/4): 254-273.

Clones of teak belonging to ten states of India were considered as experimental host plants to evaluate resistant teak clones. On the basis of data on leaf area consumed and foliar constituents, some resistant teak clones were identified.

4486 Karamohandani, K.P. 1955. **Table showing natural durability, treatability, availability, cost and uses of timber of Bombay State**. Journal of Timber Dryers' Preservation Association 1(1): 10-11.

Information on natural durability of heartwood, treatability, quantity available annually in tons, price per ton, uses of teak is given.

4487 Kumar, S. 1971 . **Causes of natural durability in timber**. Journal of Timber Development Association of India 17(2): 1-15.

Reference is made to heartwood extractives responsible for decay resistance in species including teak is given. The effects of anatomical structure and of the presence of nutrient materials in the wood on its durability are considered.

4488 Lely, W.G. 1941. **Fire-resisting doors**. Wood 6: 40-41.

The fire resisting qualities of teak are emphasized.

4489 Maheswarappa, V; Naik, S.T. 2002. **Reaction of different clones of teak (*Tectona grandis*) against rust caused by *Olivea tectonae***. Plant Pathology Newsletter 20: 14-17.

A study was undertaken in Uttara Kannada, Karnataka to identify the teak clones resistant to rust. Out of the twenty five clones evaluated, four clones were completely free from the disease. Biochemical analyses were carried out for phenols and sugars in selected clones that showed different degree of rust resistance.

4490 Meshram, P.B; Joshi, K.C; Sarkar, A.K. 1994. **Relative resistance of certain clones of *Tectona grandis* to teak leaf skeletonizer, *Eutectona machaeralis* Walk. (Lepidoptera: Pyralidae)**. Indian Forester 120(1): 58-61.

Selected clones of teak from ten Indian states for resistance to various pests and diseases, were raised in polybags at the Tropical Forest Research Institute, Madhya Pradesh. Fresh leaves of the clones were tested against larva of the teak skeletonizer, *Eutectona machaeralis*.

4491 Mishra, S.C. 1992. **Comparative natural resistance of different clones of *Tectona grandis* Linn.f. to teak skeletoniser *Eutectona machaeralis* Wlk. (Lepidoptera: Pyralidae)**. Indian Forester 118(4): 274-278.

Sixteen clones of teak maintained in the teak germplasm bank at New Forest, Dehra Dun were evaluated for their natural variation in susceptibility to fourth-instar larvae of *Eutectona machaeralis* in laboratory.

4492 Mukhtar, A. 1987. **Relative resistance of different clones of *Tectona grandis* to teak defoliator, *Hyblaea puera* Cram (Lepidoptera: Hyblaeidae) in south India**. Indian Forester 113(4): 281-286.

Teak clones from Tamil Nadu, Kerala and Andhra Pradesh were planted in the clonal teak orchards at the field station of the Southern Forest Research Station at Walayar, Kerala. Susceptibility to *H. puera* was measured and clones from Tamil Nadu are the least preferred.

4493 Nair, K.S.S; Kedharnath, S; Koshy, M.P; Sudheendrakumar, V.V; Mohanadas, K; Varma, R.V; Mathew, G. 1989. **Search for natural resistance to the insect pests, *Hyblaea puera* in teak**. KFRI Research Report 62: 32p. Kerala Forest Research Institute, Peechi.

A search was made in Kerala for teak clones resistant to attack by the defoliator, *Hyblaea puera*, by examining extensive areas of plantations, natural forests and seed orchards. Many isolated trees were found unattacked amid totally defoliated trees. Standard methods were developed for screening trees for defoliator resistance and an artificial diet was developed for laboratory rearing of *H. puera*.

4494 Nair, K.S.S; Sudheendrakumar, V.V; Mohanadas, K; Varma, R.V; Mathew, G; Koshy, M.P; Kedharnath, S. 1997. **Search for teak trees resistant to the defoliator, *Hyblaea puera* Cramer (Lepidoptera, Hyblaeidae)**. Ecology and Evolution of Plant Feeding Insects in Natural and Man-made Environments: 109-122. A. Raman, Ed. International Scientific Pub., New Delhi.

A search for teak trees resistant to attack from the defoliator, *Hyblaea puera* is made in Kerala, by surveying extensive areas of plantations, clonal seed orchards and natural forests, during periods of defoliator outbreak.

4495 Narayanamurti, D. 1962. **Further note on the electrical resistance of Indian timbers**. Paintindia 12(3): 15-18.

Gives resistance values of twenty four species including *Tectona grandis* at five different moisture contents.

4496 Narayanamurti, D; Gupta, R.C; Verma, G.M. 1962. **Influence of extractives on the setting of adhesives**. Holzforschung und Holzverwertung 14(5/6): 85-88.

Studies the effect of extractives from *Acacia catechu* and *Tectona grandis* on the gelation time and rigidity modulus of adhesives.

4497 Narayanamurti, D; Jain, N.C; George, J; Pant, H.C. 1963. **Fungus resistance of Rajasthan teak**. Research and Industry 8(4): 97-98.

The resistance of the low girth Rajasthan teak to brown rot and *Polystictus versicolor* was studied.

4498 Narayanamurti, D; Verma, G.M. 1963 . **The effect of size of timber specimens on their decay resistance**. (English; German). Holzforschung und Holzverwertung 15(2): 30-33.

Studies on the resistance of *Acacia catechu*, *Dalbergia sissoo* and *Tectona grandis* to *Polystictus versicolor* revealed a straight-line relationship between weight loss and area of specimen.

4499 Parihar, D.R. 1997. **Field evaluation of natural resistance of timber and fuel wood against termite attack**. Annals of Arid Zone 36(1): 61-64.

The resistance of timber wood including *Tectona grandis* and fuel wood species to termite attack was assessed.

4500 Parkes, W. 1864. **Durability of teak**. Minutes of the Proceedings, Institute of Civil Engineering, London 23: p39.

4501 Popham, F.J. 1932. **Durability tests on untreated Indian timbers**. Indian Forester 58(1): 9-19.

Gives results of tests of seventy nine Indian timbers including teak and an account of the procedure adopted.

4502 Prasad, B.N; Jain, N.C; Chelvarajan, B.K. 1964. **Observations on the durability of South Indian timbers in treated and untreated condition**. Indian Forester 90(1): 32-39.

Average life of *Tectona grandis* is reported as 84 to 119 months. The heartwood of *Tectona grandis* is very refractory to treatment.

4503 Premrasme, T. 1957. **The durability of teak**. Vanasarn 15(3): 23-28.

The durability of teak wood found at Mahatat monastery, Ayuthia is described, which king Ramesanan built in 1484 A.D. The teak wood are still in sound condition.

4504 Puri, Y.N. 1967. **Natural decay resistance of Indian timbers. III. Heartwood extractives of sal (*Shorea robusta* Gaertn.) and teak (*Tectona grandis* Linn.f.)**. Indian Forester 93(7): 447-454.

Samples of *Tectona grandis* and *Shorea robusta* were tested for decay resistance after treating with various solvents.

4505 Raveendran, T.V; Wagh, A.B. 1990. **Studies on the durability of twenty species of Andaman timbers in Goa waters**. Journal of the Indian Academy of Wood Science 21(2): 9-16.

Twenty species of timber including teak from the Andaman group of Islands were exposed in Goa harbour waters. The main marine borers were *Martesia striata* and *Lyrodus pedicellatus*. *Tectona grandis* is found very resistant.

4506 Roychoudhury, N. 2002. **Relative resistance in teak clones to leaf skeletonizer, *Eutectona machaeralis* (Walker) (Lepidoptera: Pyralidae) and role of leaf moisture**. Entomon 27(2): 211-214.

Fourteen clones of teak from Andhra Pradesh, Tamil Nadu, Orissa, Maharashtra and Uttar Pradesh were screened for relative resistance against the insect pest, *Eutectona machaeralis*. Water content of contributory leaves of teak clones revealed a gradual increase in relation to leaf area consumption.

4507 Roychoudhury, N; Bhowmik, A.K; Jain, A; Joshi, K.C; Banerjee, S.K. 1998. **Relative resistance in teak clones to *Spodoptera litura* (Fabricius) Boursin (Lepidoptera: Noctuidae), in relation to certain leaf nutrients**. Indian Journal of Forestry 21(4): 321-326.

The relative natural resistance to *Spodoptera litura* of teak clones was determined by field observations at Jabalpur, Maharashtra and feeding bioassays in laboratory. Leaves of the different clones showed a gradual increase in leaf water contents in relation to leaf consumption.

4508 Roychoudhury, N; Jain, A; Joshi, K.C. 1995. **Resistance in teak clones against leaf skeletonizer, *Eutectona machaeralis* Walker (Lepidoptera: Pyralidae)**. Advances in Forestry Research in India 13: 140-157.

The results are reported of laboratory and field evaluations of the resistance of clones of teak from ten states to *Eutectona machaeralis*. Tests in which leaf extracts of resistant clones were sprayed onto susceptible leaves, indicated the possibility that factors in the leaves determined feeding potential for the pest.

4509 Roychoudhury, N; Jain, A; Joshi, K.C; Lal, R.B. 1997. **Natural resistance in teak clones to leaf skeletonizer *Eutectona machaeralis* walker: An appraisal**. Indian Forester 123(11): 1027-1035.

Research on the natural resistance of teak clones against insect pest in India, *Eutectona machaeralis*, is described. Aspects discussed are mechanisms of natural resistance and their exploitation and clonal resistance -

including the identification and selection of resistant genotypes.

4510 Roychoudhury, N; Joshi, K.C. 1996. **Search for natural resistance in teak clones against *Eutectona machaeralis* Walker (Lepidoptera: Pyralidae)**. Indian Journal of Forestry 19(3): 205-213.

Clones of teak from ten Indian states were evaluated for possible natural resistance to the pest, *Eutectona machaeralis*. The study revealed that the clone from Orissa was the most resistant. The remaining clones were ranked as highly resistant, resistant, moderately resistant, least resistant, moderately susceptible, susceptible, highly susceptible and most susceptible.

4511 Rudman, P. 1958. **Relationship on tectoquinone to durability in *Tectona grandis***. Nature 181(4610): 721-722.

It is found in the laboratory that tectoquinone present in teak heartwood shows no sign of toxicity for wood destroying fungi, its effect on subterranean termites is slight and it is not solely responsible for the termite resistance of teak.

4512 Rudman, P. 1959. **Factors affecting the durability of teak**. Commonwealth Scientific and Industrial Research Organization, Australia, Forest Products Newsletter 253: 1-2.

4513 Rudman, P. 1961. **The causes of natural durability in timber. Pt. VII. The causes of decay resistance in teak (*Tectona grandis* Linn.f.)**. Holzforschung 15(5): 151-156.

The causes of decay resistance in teak heartwood were studied, paper chromatography and counter current distribution being used to fractionate the crude heartwood extractives, and the resulting fractions and pure compounds then tested for antifungal activity by measuring the rate of decay of impregnated sawdust.

4514 Rudman, P; Costa, E.W.B da. 1960. **Investigations on the durability of teak**. FAO Teak Sub-Commission, New-Delhi FAO/TSC.

Laboratory investigations on the durability of teak wood, chemical basis of decay and termite resistance of teak wood, relationship of durability to genetic and silvicultural factors, implications of the results in silvicultural practice, requirements for future work and establishment of tree breeding and silvicultural experiments are discussed.

4515 Rudman, P; Costa, E.W.B da; Gay, F.J. 1967. **Wood quality in plus trees of teak (*Tectona grandis* Linn.f.)**. Silvae Genetica 16(3): 102-105.

The teak improvement programme of the Papua and New Guinea Department of Forests includes the establishment of a seed orchard of second generation teak at Keravat in New Britain. Decay resistance was tested with *Coniophora olivacea* and *Coriolus versicolor* on wood specimens, while termite resistance was tested with laboratory colonies of *Coptotermes lacteus*.

4516 Rudman, P; Gay, F.J. 1961. **The causes of natural durability in timber. VI. Measurement of anti-termite properties of anthraquinones from *Tectona grandis* Linn. f. by a rapid semi-micromethod**. Holzforschung und Holzverwertung 15(4): 117-120.

A new rapid semi micro quantitative method has been developed for evaluating anti termite activity and its use is illustrated in the testing of four anthraquinones and two anthrones.

4517 Santhakumaran, L.N. 1969. **Preliminary observations on the relative resistance of selected species of Indian timber to gribble (Limnoria) attack**. Journal of the Bombay Natural History Society 66(1): 203-210.

Following an outbreak of damage by *Limnoria bombayensis* in Bombay harbour panels of twenty five species were exposed for 14 or 18 months. Panels of *Shorea robusta* and *Tectona grandis* were free from attack but other species were attacked.

4518 Santhakumaran, L.N. 1973. **On the natural resistance of *Lannea coromandelica*, *Tetrameles nudiflora* and *Tectona grandis* to marine borers in Bombay harbour**. Journal of the Timber Development Association of India 19(3): 26-30.

The nature and extent of damage to panels of the three timbers after 8.5 months' exposure are recorded. All the timbers showed good natural resistance to borers.

4519 Santhakumaran, L.N; Alikunhi, K.H. 1983. **Natural resistance of different species of Indian timbers to marine wood borers in Bombay waters**. Indian Forest Bulletin 272; Wood Preservation, Controller of Publication, New Delhi: 46p.

4520 Santhakumarn, L.N. 1986. **Further studies on the natural durability of Indian timbers in Goa waters against marine wood borers**.

Proceedings of the National Academical Science, India 56(B), II: 133-138.

4521 Savard, J; Andre, A.M; Guinet, P. 1960. **The resistance of tropical timbers to mineral acids**. (French). Bois For. Trop 74: 25-34.

In an attempt to classify some tropical hardwoods according to their resistance to HCl, HNO_3, and H_2SO_4, test pieces were soaked under conditions similar to those in industrial use and measurements were made of their absorption rate, weight loss and dimensional variability.

4522 Schultz-Dewitz, C. 1960. **Termite resistance tests on seven exotics**. (German). Holz Zentralblatt 86(99): p1379.

In tests with small specimens of 25-30 percent moisture content buried in soil and exposed to *Reticulitermes lucifugus* for four weeks. Teak from Indonesia and Siam had weight looses of only 1-3.3 percent and all termites died.

4523 Sen Sarma, P.K. 1963. **Studies on the natural resistance of timbers to termites**. Indian Forest Bulletin (n.s.) Entomology 220: 10p.

Out of forty Indian timbers tested, the most resistant species identified include *Tectona grandis*.

4524 Sen Sarma, P.K; Chatterjee, P.N. 1968. **Studies on the natural resistance of timbers to termite attack. V. Laboratory evaluation of the resistance of three species of Indian wood to *Microcerotermes beesoni* Snyder (Termitidae: Amitermitinae)**. Indian Forester 94(9): 694-704.

Wood sampling techniques, culturing of termites and testing of wood resistance to termites are described in detail. *Tectona grandis* is classed as very resistant.

4525 Sen Sarma, P.K; Thakur, M.L. 1979. **Relative termite resistance of heartwood of teak trees from known seed sources**. Holzforschung und Holzverwertung 31(1): 14-16.

Laboratory studies were carried out in India to determine the resistance to *Microcerotermes beesoni* of 400 samples of heartwood taken from teak trees and to ascertain whether resistance was controlled by herditary or environmental factors. The results indicated that seed source played a greater role than environmental factors.

4526 Southwell, C.R; Bultman, J.D. 1971. **Marine borer resistance of untreated woods over long periods of immersion in tropical waters**. Biotropica 3(1): 81-107.

Wood from 115 species was exposed to the three principal classes of borer in underwater sites in the Panama Canal Zone. Data are tabulated showing degree of damage to each wood species. Some woods including teak were resistant to borers.

4527 Supriana, N. 1988. **Studies on the natural durability of tropical timbers to termite attack**. International Biodeterioration 24(4/5): 337-341.

Small samples of tropical timbers were tested against the dry wood termite, *Cryptotermes cynocephalus* and the subterranean termite *Coptotermes curvignathus*. Four species including teak were found completely durable against both termites.

4528 Supriana, N; Howse, P.E. 1982. **Termite resistance of twenty eight Indonesian timbers**. International Research Group on Wood Preservation, Working Group I, Biological Problems. Document IRG-WP-1150: 14p.

Samples of species including teak were tested for resistance to the dry wood termite, *Cryptotermes cynocephalus* and the subterranean termite, *Coptotermes curvignathus*. *Tectona grandis* is found completely resistant to both species of termites.

4529 Tewari, M.C; Pant, S.C. 1974. **Natural durability by accelerated field trials of natural and plantation grown teak**. Journal of the Timber Development Association of India 20(2): 1-2.

The results of observations on the extent of termite attack on specimens of teak heartwood exposed to eighteen years at four sites in India and Burma are given. No significant difference was found between the average life of specimens prepared from plantation grown and natural grown teak.

4530 Torres, L; Silverborg, S.B. 1972. **Study on the natural durability of teak by means of accelerated soil/block tests in the National Forest Products Laboratory, Merida, Venezuela**. Boletin, Instituto Forestal Latino Americano 41-42: 63-70.

The fungus *Ustulina deusta* has been identified attacking the base of teak trees in a plantation in Venezuela, and causing the death of some trees. Soil/block tests were made to determine the resistance of sapwood and heartwood of teak to *U. deusta* and *Polyporus versicolor* and *Lenzites trabea*.

4531 Wolcott, G.N. 1946. **Factors in the natural resistance of woods to termite attack**. Caribbean Forester 7(3): 121-134; 139-149.

The most effective of the quinones tested are tectoquinone, which is presented in large amounts in East Indian teak to account for its well known resistance to termites.

4532 Yoshimura, M. 1962. **Decay resistance of several tropical and U.P. woods extracted with hot water to *Polyporus versicolor* and *Poria monticola***. (Japanese; English). Bulletin of Faculty of Agriculture, Mie Daigaku Noyakubu University 26: 143-170.

Wafers extracted in hot water and exposed to *Polyporus monticola*, showed correlation between weight loss and moisture content. In extracted specimens special grade was more related to resistance than in controls.

4533 Yoshimura, M. 1962. **The effect of hot water extractives - several tropical and U.S. woods on the growth of *Polyporus versicolor* and *Poria monticola***. (Japanese). Bulletin of Faculty of Agriculture, Mie Daigaku Noyakubu University 25: 99-122.

The effect of the extractives from 10 tropical species including teak varied greatly between species and test fungi, and there was no close correlation between toxicity of the extractive and the durability of the wood.

4534 Yoshimura, M. 1963. **Effect of extractives upon decay resistance of wood**. (Japanese; English). Mie Daigaku Nogakubu Gakujutsu Hokoku 27: 225-325.

The effect of different extractives and fungal species and decay resistance of various woods is studied and extraction by Et2O diminished decay resistance of teak. The weight loss due to the decay was proportional to the amount of extracted material and also to the reduction in specific gravity.

Go top

Preservative Treatments

4535 **Air seasoning-girdled trees and log seasoning**. Forest Research in India and Burma 1945-46, Part I, 1947: 43-45.

After four months of extraction, teak logs are floating with 1/4 of volume above water. When girdled and kept of three years drying logs in greater than other species.

4536 **Seasoning of girdled trees**. For. Res. India Burma 1945-6, Pt. 1, 1947: 44-45.

A set of girdled trees of *Tectona grandis*, *Xylia xylocarpa*, *Hopea parviflora* and *Ougeinia dalbergioides* were felled after having been kept girdled for three years. Drying was found greater in teak than in other logs and longitudinal cracks in them were attacked by borers.

4537 Alliot, H. 1947. **The protection of timber against termites**. Les techniques du bois 2: 138-140.

The preservatives used in the tests were creosote, pentachlorophenol, DDT, and hexa-chloro-cyclo-hexane. Tests were also made for natural resistance to termite attack. The most resistant species include *Tectona grandis*.

4538 Barber, H. 1940. **Air drying tests on Burma timbers being a record of observations made during the period 1925 to 1936**. Burma Forest Bulletin 33(8): 70p.

A record of drying observations for fifty species including teak indicated division of the species into very refractory, moderately refractory and non-refractory and teak is considered moderately refractory.

4539 Barnacle, J.E; Ampong, F.F.K. 1974. **Refractory intermediate wood in round teak fence posts**. Ghana Journal of Science 14(2): 193-198.

Preservative problems associated with the occurrence of a relatively wide zone of intermediate wood virtually impermeable to treatment in fence posts cut from unpruned plantation grown *Tectona grandis* trees and alternating penetrated and non penetrated bands of heartwood in some preservative treated small fence posts.

4540 Encinas, O; Contreras, W. 1998. **The use of teak (*Tectona grandis* Linn.f.) preserved with CCA as an alternative construction material for Venezuelan housing**. (Spanish). Revista Forestal Venezolana 42(2): 113-118.

Traditional folk practices are used in Venezuela to prolong the service life of small diameter thinnings of teak used in construction of low cost housing. A case study is described where thinnings treated with CCA were used to construct a house in a small town.

4541 Forest Research Institute, Dehra Dun. 1939. **Notes on teak from annual report**. Forest Administration Report, Forest Department, Bombay 1937/38. Forest Research Institute, Dehra Dun.

A wood preservative known as Cuprex prevented the decay of teak buried 1 ft. underground for one year.

4542 Kapoor, S.N. 1934. **Manual of air seasoning of Indian timbers 1934**. Forest Research Institute, Dehra Dun.

Gives air seasoning characteristics of various species including teak.

4543 Kapoor, S.N. 1939. **A manual of the air seasoning of Indian timbers 1939**. Forest Research Institute, Dehra Dun: 80-90.

Seasoning characteristics of teak timber are given on page 80-90.

4544 Kapoor, S.N; Rehman, M.A. 1939. **Notes on the air seasoning characteristics of some Indian woods**. Indian Forest Records (n.s.) Utilisation 8: 230p.

4545 Keylwerth, R; Gaiser, H; Meichsner, H. 1955. **Investigations on a seasoning plant operating with superheated steam**. (German). Holz als Roh-und Werkstoff 13(1): 5-20.

The temperature field, drying process, drying time and power consumption, as well as the distribution of air velocity, were studied in a Benno Schilde superheated steam drier of trimmed sawn timber. Both the temperature and air current fields were found to be very advantageous for seasoning purposes. Air dry broadleaved woods which include teak were seasoned at 110-127 degree.

4546 Knight, R.A.G; Armstrong, F.H. 1938. **Kiln-seasoning treatments of teak and their effects on its wearing qualities as flooring**. D.S.I.R., Forest Products Research Records 23: 14p .

An account is given of six kiln seasoning experiments on teak strips and of the effect on the floor wearing qualities of the material of kiln treatments. It is concluded that the principal factor influencing the choice of drying schedule is the characteristic variation of moisture content.

4547 Latif, M.A; Younus-uzzaman, M; De, B.C. 1981. **Pressure treatment of teak poles with oil borne preservative**. Bano Biggyan Patrika 10(1/2): 27-32.

Poles were treated with 40:60 creosote/light diesel oil by the Bethel full-cell process. The effects of varying pressures and treatment periods were evaluated on penetration and retention of the preservative.

4548 Lee, J.S; Sakuno, T; Ohsaki, T. 1990 . **The decay resistance of stain treated wood**. Research Bulletin of the Tottori University Forests 20: 39-46.

Results of accelerated decay resistance tests and anti mould tests given for veneer samples of teak treated with oil stain.

4549 Lin, R.J; Liao, K.F; Peng, S.F; Hong, K.J. 1998. **Studies of basic property of wood by sand heat treatments. (I) The effect of treating temperature on dimensional stability of wood**. Forest Products Industries 17(1): 21-35.

A study was made to modify the dimensional stability, colour change and specific gravity of wood which include teak, by heat treatment at different temperatures by sand heating. The reduction in specific gravity increased with the increasing temperature of the treatment, but it was inversely correlated with the specific gravity of the wood.

4550 Maden, M; King, B; Gulati, N; Kaur, K; Khosla, P.K. 1982. **Total nitrogen balances in some preserved and unpreserved Indian woods**. Symposium Proceedings: Improvement of forest biomass: 429-434. Indian Society of Tree Scientists, H.P. Agricultural University, Solan.

The relations between nitrogen content of wood including teak in soil contact and fungal colonization and decay are discussed.

4551 Martawijaya, A. 1988. **Discoloration of teak wood due to kiln drying**. Duta Rimba 14(101/102): 3-10 (In); 11-16 (En).

Possible factors influencing the discoloration of teak during kiln drying are discussed. The factors include kiln temperature and humidity and the surface accumulation and oxidation of wood extractives.

4552 Nussbaum, R.M. 1993. **Oxidative activation of wood surfaces by flame treatment**. Wood Science and Technology 27(3): 183-193.

Veneers of teak, pine and birch were oxidized by flame treatment. Wettability was increased and microbiological activity was reduced by the sterilizing effect of the treatment. Electron spectroscopy for chemical analysis measurements showed an increase in oxidation level as a result of the flame treatment.

4553 Pearson, R.S. 1919. **Experiment carried out to determine the contraction across the grain which takes place in teak: (*Tectona grandis*) while seasoning**. Indian Forester 45(9): 462-464.

4554 Purushotham, A (et al). 1958. **Preliminary note on the high pressure treatment of timber with wood preservatives**. Journal of Timber Dryers' Preservation Association 4(2): 29-34.

Tectona grandis is one of the species dealth with.

4555 Purushotham, A; Vidyasagar. 1956. **Note on the treatment of timber poles by the Boucherie process**. Journal of Timber Dryers' Preservation Association 2(2): 14-16.

Tectona grandis is one of the species dealt with.

4556 Ranganathan, S.K; Aziz, M.A; Koshi, T; Sankaran, V. 1949. **Studies in contact toxicity. Part II. Reactivation of surface treated with dichloro diphenyl trichloroethane (DDT) by storage in a Burma teak box**. Indian Academy of Sciences Proceedings 30B(3): 176-184.

The toxicity of glass surfaces treated with DDT, exhibiting only feeble activity against *Culex fatigans*, was found to be renewed after storage in a Burma teak box. Storage in boxes of species including teak had no effect on the toxicity.

4557 Reddy, G.V.N; Reddy, M.R. 1985. **Effect of chemical treatment or pelleting of saw dust on chemical composition and in vitro digestibility**. Indian Journal of Animal Nutrition 2(4): 171-174.

Effect of teak sawdust treated with H_2O_2, H_2SO_4, NaOH, NH_3 and steam pelleting on chemical composition is studied. Pelleting and H_2O_2 treatment had little effect on composition and digestibility of sawdust.

4558 Rehman, M.A. 1939. **The seasoning behaviour of Indian timbers**. Indian Forest Bulletin (n.s.) Wood Seasoning 170.

4559 Rehman, M.A. 1943. **Air condenser kiln suitable for the seasoning of cooperage woods and packing case timbers**. Indian Forest Leaflet (Utilisation) 43: 6p.

A description is given of a natural draft furnace heated kiln designed primarily for the seasoning of cooperage woods and packing case timbers including teak.

4560 Rehman, M.A. 1955. **Seasoning behaviour of Indian timbers Part II (Kiln drying schedules)**. Indian Forester 79(7): 369-375.

Teak is included in kiln drying schedule V. The tentative schedule for 1 inch thick planks of *Tectona grandis* is given. Teak timber will take 13-16 days to season. In addition to the initial steaming, the timber may need two intermediate and one final steaming at 55 degree C/100 percent R.H. for 2-4 hours.

4561 Sales, C. 1979. **Some seasoning times**. (French). Bois et Forests des Tropiques 186: 52-53.

A list of twenty three tropical species including teak, giving the seasoning times necessary to bring pieces of wood of various thickness to an average moisture content of 12 percent.

4562 Samapudhi, K. 1954. **The rate of drying of teak logs**. (Siam; English). Vanasarn 12(1): 63-68.

Logs cut green and stored, unbarked, in a well ventilated room had dried to constant weight within 18 months.

4563 Santhakumaran, L.N; Krishnan, R.V. 1991. **Resistance of six timber species treated with CCA and CCB, against marine borer attack in Goa waters**. The International Research Group on Wood Preservation, Stockholm IRG/WP/4166: 1-14.

Included teak.

4564 Sattar, M.A. 1987. **Comparative studies of wood seasoning with a special reference to solar drying**. Bano Biggyan Patrika 16(1/2): 30-42.

Data are reported of drying studies with twenty species including teak in Bangladesh, using solar drying, conventional air drying and steam heated kiln drying.

4565 Sattar, M.A; Talukdar, Y.A; Ali, M.O. 1973. **Studies on dimensional stability and variation in moisture content of kiln dried wood samples of ten indigenous species of Bangladesh**. Bano Biggyan Patrika 5(2): 1-20.

Sawn samples were prepared from kiln-dried lumber of each of ten tree species including teak, one set was suspended in an open shed, while the other was placed in-doors. Measurements were made at monthly intervals of changes in weight and structural dimensions over a 17-month period. The smallest dimensional changes occurred in samples of *Tectona grandis*.

4566 Selaphat, J. 1968. **Effect of heat treatment on static bending of teak**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The static bending property when heated at 150 degree C increases upto three hour period and later on for next three hours it decreases. At 200 degree C the static bending property go down with time of heating.

4567 Seneviratne, E.W. 1981. **Results of seasoning trials with some local timbers**. Sri Lanka Forester 15(1/2): 30-33.

Results are given of air seasoning and kiln seasoning trials with species including teak from Sri Lanka.

4568 Videlov, K.H; Ullevalseter, R.O. 1974. **Investigation on the work of a lumber kiln using the condensation effect**. (Bulgarian). D'rvoobrabotvashcha i Mebelna Promishlenost 17(6): 7-14.

Describes the dehumidification kiln developed in Norway and gives the results of drying trials with teak lumber and different initial moisture content.

4569 Wu, H.T; Lin, J.S. 1997. **Study on the kiln drying of teak, India-charcoal trema, *Formosan alder* and schefflera tree 3-cm thick lumber**. Bulletin of National Pingtung Polytechnic Institute 6(1): 41-48.

Four species of lumber including teak were dried with high temperature drying, conventional kiln drying and conventional high temperature drying. Drying with high temperature drying could reduce drying time by about 57 percent and energy consumption was reduced by about 38 percent compared with conventional kiln drying.

4570 Yoneta, M; Mamun, J. 1996 . **Kiln drying test of three papua new guinea woods**. Journal of the Hokkaido Forest Products Research Institute 10(2): 14-21.

The present study aims to find out an optimum schedule for drying Papua New Guinea plantation and lesser used wood species including teak in a kiln. The following three tests were performed, quick drying tests at 100 degree C, tests of drying rates at 60 degree C, and tests of drying schedules with boards of commercial sizes.

Go top

Wood Grading

4571 **Grading of Indonesian teak**. Proceedings of the Technical Meeting on Standardization of Nomenclature, Terminology, Testing Methods, Grading and Dimensions of Timber, Dalat, Vietnam, 1950 F50/FE/14, 1950: 6p.

Rules for export squares, export flitches and sleepers.

4572 **Timber grading in Thailand**. Proceedings of the F.A.O. Technical Meeting on Standardization of Nomenclature, Terminology, Testing Methods, Grading and Dimensions of Timber, Dalat, Vietnam, 1950, No. F50/FE/16, 1950: 7p.

Manufacturers' lumber grading rules, chiefly for teak.

4573 **Asia-Pacific regional grading rules for teak-logs**. Asia-Pacific Forestry Commission, 1959: 52p.

4574 **Indian railway standard specification for hardwood logs**. RDSO K1-65, Lucknow, 1965.

4575 **Specification of structural timber in buildings**. BIS, New Delhi, 1986.

4576 **Grading rule of teak wood in Perum Perhutani**. Proceedings of the 3rd Regional Seminar on Teak, Yogyakarta, Indonesia, 2000: 2-4.

4577 Balasundaran, M; Gnanaharan, R. 1997. **Timber defects of plantation grown teak and their implication on wood quality**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 129-134. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Research Institute, Peechi.

A survey was made of common timber defects of teak raised in plantations. The most serious defects were fire marks, rind galls, occluded branches and occluded wounds. Prevention of fire and proper and timely thinning of the teak plantations are suggested to reduce erosion in timber quality.

4578 Bhat, K.M. 2000. **Technology packages for quality wood products of teak plantations: Challenges and promises for the 21st century**. Group Session of 21th IUFRO World Conferences, Kuala Lumpur, Malaysia 5.06402.

4579 Chew L.T. 2003. **Malaysia's experience in timber certification**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

MTCC is an independent organisation established to operate a voluntary national timber certification scheme in Malaysia. The external and internal challenges faced by MTCC in implementing the certification scheme, as well as the main impacts of the scheme are highlighted.

4580 FAO. 1955. **Standard grading for imported teak (squares and sawn-lumber) Japan**. FAO/Asia-Pacific Forestry Commission, Tokyo FAO/APFC-55/64: 11p.

4581 FAO. 1956. **Draft South East Asia grading rules for teak conversion**. FAO Teak Sub-Commission, Bangkok FAO/TSC-56/11: 5p.

4582 FAO. 1956. **Draft South East Asia grading rules for teak squares**. FAO Teak Sub-Commission, Bangkok FAO/TSC-56/13: 12p.

4583 FAO. 1956. **Draft South East Asia grading rules for teak-logs**. FAO Teak Sub-Commission, Bangkok FAO/TSC-56/14: 16p.

4584 FAO. 1957. **Comments on the FAO draft teak grading rules (logs, squares and conversions) by the timber trade federation of the United Kingdom**. FAO Teak Sub-Commission, Bangkok FAO/TSC-57/16: 12p.

4585 FAO. 1957. **Final draft for S.E.A. grading rules for teak squares**. FAO Teak Sub-Commission, Bangkok FAO/TSC-57/12: 12p.

4586 FAO. 1957. **Final draft S.E.A. grading rules for teak-logs**. FAO Teak Sub-Commission, Bangkok FAO/TSC-57/14.

4587 FAO. 1957. **Final draft S.E.A. grading rules for teak conversions**. FAO Teak Sub-Commission, Bangkok FAO/TSC-57/15: 11p.

4588 FAO. 1958. **Asia-Pacific regional grading rules for teak squares**. FAO, Rome FAO/TSC-57 B Rev. 1: 26p.

These rules, approved at the Second Session of the Teak Sub-Committee at Bandung in 1957, are based largely on the Seaman-Limaye Rules of 1936.

4589 FAO. 1960. **Report of the ad hoc committee on teak grading**. FAO Teak Sub-Commission, New Delhi FAO/TSC-60/6/4: 3p.

Recommendations are made on further study and observations for teak grading teak squares, teak logs and teak conversions are made.

4590 FAO. 1960. **Report of the study group on teak grading**. FAO Teak Sub-Commission, New Delhi FAO/TSC-60/6/1: 1p.

Report of the study group on teak grading with draft rules for teak squares, teak logs and teak conversions presented for consideration and incorporation.

4591 FAO. 1962. **Draft Asia-Pacific grading rules for teak conversion other than squares**. FAO/Asia-Pacific Forestry Commission: 7p.

4592 Forest Department, Burma. 1939. **The valuation of round teak logs**. Forest Department, Rangoon, Burma: 22p.

4593 Gallant, M.N. 1939. **Classification of teak logs**. FRI, India: 28p.

4594 Gresser, E. 1932. **Notes on the knotty variety of teak**. (Dutch; English). Tectona 25: 269-272.

4595 Indian Standards Institute, New Delhi. 1963. **Classification of commercial timbers and their Zonal distribution (revised) IS: 399**. Indian Standards Institute, New Delhi .

Gives the following information on *Tectona grandis*. Its average weight, durability-high treatability heartwood only partially treatable, refractoriness to air seasoning.

4596 Indian Standards Institution, New Delhi. 1966. **Indian standard grading rules for teak squares**. Indian Standard IS 3731: 11p. Indian Standards Institution, New Delhi.

Covers the requirements for various grades of *Tectona grandis* squared logs based on defects.

4597 Indian Standards Institute, New Delhi. 1985. **Grading rules for teak logs**. Indian Standard 33641-1985. Indian Standards Institution, New Delhi.

4598 Karsoedjono; Tedjokoesoemo, R.H. 1956. **Teak grading rules (Indonesia)**. FAO Teak Sub-Commission, Bangkok FAO/TSC/56/24.

4599 Limaye, V.D. 1952. **The timber grading school at Singapore**. Indian Forester 78: p252.

Lists the subjects on theory of teak grading on which lectures were delivered at International timber grading school at Kepong in Malaya.

4600 Limaye, V.D. 1957. **Grouping of Indian timbers and their properties, uses and suitability**. Indian Forest Records (n.s.) Timber Mechanics 1(2): 19-64.

Grouping of timbers according to their suitability values for each property, properties and uses of each timber species, the average weight and the observed maximum and minimum weights of each species and charts showing the suitability of species by means of stick-diagrams.

4601 Menon, K.D. 1979. **Grading and standardization in major timber producing countries in the South East Asian region**. Economic Commission for Europe, Timber Committee: Seminar on the utilization of tropical hardwoods, Amsterdam (Netherlands), 15-18 May 1979, TIM-SEM.8-R.12: 8p.

Regulations and current procedures are described for grading of teak and non-teak hardwood logs and sawn timber, teak squares and plywood in Burma, Indonesia, Malaysia, Philippines and Thailand.

4602 Rajput, S.S; Gulati, A.S. 1983. **A note on the classification of timbers for doors and windows**. Journal of the Timber Development Association of India 29(1): 13-20.

It is suggested that timbers should be classified according to a strength factor, which is calculated from weight relative to teak, strength as a beam, suitability as a post or strut, splitting coefficient, nail/screw holding properties and retention of shape.

4603 Rajput, S.S; Gulati, A.S. 1983. **Some considerations on the selection of reference timber for comparison in the evaluation of suitability indices of Indian timbers**. Journal of the Indian Academy of Wood Science 14(2): 96-102.

Data are tabulated and analysed for fourteen samples of teak from different locations in India and an average Indian teak was derived and the physical and mechanical properties and suitability indices for nine purposes are given for this average teak which will serve as the revised reference timber.

4604 Ranatunga, M.S. 1979. **Timber grading and scaling**. Sri Lanka Forester 14(1/2): 67-69.

A brief introductory survey is given of the rules followed in Malaysia, Indonesia, Philippines and Burma, with particular reference to log grading.

4605 Rao, K.S. 2003. **Certification and labelling of wood products with special reference to opportunities and problems for teak in India**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

An attempt is made to examine the opportunities, constraints and apprehensions concerning timber certification and its labelling in India with special reference to teak.

4606 Royal Forest Department, Bangkok. 1964. **Proposed grading rules for teak veneer logs**. Royal Forest Department, Bangkok: 1-6. Forest Department, Thailand.

The defects are defined and illustrated.

4607 Seaman, I.N; Limaye, V.D. 1935. **Rules for the grading of teak squares**. Government of India Publication: 19p.

4608 Sekhar, A.C; Sharma, R.S. 1967. **Practical application of shrinkage values in grading of timber**. Indian Forester 93(2): 98-106.

Derives formulae for the calculation of radial and tangential shrinkage values of timber dried from green to oven dry and green to twelve percent moisture content.

4609 Sriklam, I. 1961. **Teak classification Keen's method**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Teak was classified by this method into four diameter class with 30-50 cm, 50-70 cm, 70-100 cm and over 100 cm and in each class trees were classified into, best, moderate and poor.

4610 State Timber Board, Burma. 1963. **Grading rules for teak veneer logs**. State Timber Board, Burma: 11p.

Gives definitions, system of grading, general requirements etc. and the rules are illustrated with figures and the allowances shown for various defects is given in a schedule of grading rules for teak veneer logs.

4611 Trockenbrodt, M; Josue, J. 1999. **Wood properties and utilisation potential of plantation teak (*Tectona grandis*) in Malaysia - a critical review**. Journal of Tropical Forest Products 5(1): 58-70.

Shows that the most technological properties of the timber produced in plantations will not differ significantly from mature plantation teak or naturally grown teak. The only differences are in the natural durability and the frequency of defects such as knots and shakes. The main limiting factors for young plantation teak are the comparatively small stem diameter at breast height and hence the smaller diameter of the heartwood at breast height.

4612 Tze, W.T.Y. 1999. **Recovery and quality of lumber from mature teak (*Tectona grandis*) planted in Sabah, Malaysia**. Journal of Tropical Forest Products 5(2): 115-123.

A study was made to determine the graded lumber recovery of teak logs and to examine the related natural defects of the timber. The results of this study can be used to visualize the minimum yield and quality of the lumber to be expected. The data can be useful for both considerations of commercial teak planting and management of lumber production.

4613 Warta, A.J. 1926. **Classification and sizes of teak exported from Java**. Tectona 19: 848-854.

The specification of teak exported from Jave to Europe are given and compared with those applied to the same timber from British India, and Siam for the markets of Europe and North America.

4614 Wehlburg, A.F. 1910. **Classification of teak at the growing area**. Tectona 2(1): 1-14.

Go top

Wood Utilisation

4615 **Teak wood**. Indian Forester 41(12), 1915: 503-504.

Gives an account of various uses to which teak timber was put in Europe.

4616 **Teak timber recommended for carriage and wagon building**. Timber Dryers' Preservations Association 2(3), 1956: 15p.

Teak timber recommended for the construction of various parts of passenger coaches is listed.

4617 Arief, S.M. 1953. **Investigations on the weight of firewood**. (Javanese). Rimba Indonesia 2(10/12): 413-423. (Communication of Forest Research Institute, Bogor Bo. 41, 1953).

The average weights obtained differed from those for 1921 and 1922), probably because of differences in measurements of the assortments and in the length of time between felling and measurement.

4618 Brascamp, E.H.B. 1916. **Was the tower of Babel of teakwood?** Tectona 9: p894.

It has been discovered that Indian teak was used in the building of the temples of Babylonia.

4619 Brascamp, E.H.B. 1918. **The discovery of teak woods of Oangasana in 1727 in the Colonial Archief No.VIII**. (Indonesian; English). Tectona 11: 723-743.

4620 Brascamp, E.H.B. 1919. **About the teak woods of Damasces in 1772 in Kolonial Archief No. XII**. Tectona 12: 445-460.

4621 Carapiett, J.B. 1960. **Notes on ornamental timbers of Burma**. Burmese Forester 10(1): 37-53.

Gives notes on distribution, wood properties, and uses of teak and other species.

4622 Chaves, E; Fonseca, W. 1991. **Teak (*Tectona grandis* Linn.f.) tree of multiple use in Central America**. Turrialba: p60.

4623 Classen, J.C van R. 1908. **Notes on teak**. (Indonesian; English). Tectona 1: 163-169.

4624 Contreras Miranda, W; Contreras, M.O de. 2000. **Mucunutan I - structure housing prototype for Venezuelan Andes highland rural modern houses using timber and alternative constructive technologies**. (Spanish). Revista Forestal Venezolana 44(2): 53-61.

The structure was developed using small diameter, rounded and CCA preserved teak. The feasibility of architectural and structural design was demonstrated.

4625 De Patel, K.V. 1953. **Wooden posts for telecommunication lines**. Telecommunications, Jabalpur 3(1): 13-16.

Describes the experience of the former Travancore state administration in the use of Ascu-treated teak poles for telecommunication lines.

4626 Diggelen, C.H.P.C.van. 1922. **Mixture of the products of the Government teakwood etc. 1916 to 1922**. Tectona 15: 541-544.

4627 Dommergues, Y; Maheut, J. 1962. **Utilisation du teak. Pour la Mise en valeur des forests de basse et Moyenne Casamance**. Conference des Nations Unies sur, Applications de la Science et de la Technique E. Conf. 39/c/45: 4, FAO, Rome.

4628 Draaisma, C.L.M. 1917. **A rational exploitation of teakwood**. Tectona 14: 525-534.

4629 FAO. 1957. **Activities of the utilisation working party**. FAO Teak Sub-Commission, Bandung FAO/TSC-57/11: 5p.

4630 FAO. 1957. **Note on utilisation of teak: Indonesia-III. Conversion**. FAO Teak Sub-Commission, Bandung FAO/TSC-57/30: 2p.

Sawing, veneer cutting, storage, treatment, rotary and excentric cutting, glueing and pressing and prospects of a new market for teak veneers for profitable utilization are dealt with.

4631 Forest Products Research Board, London. 1952. **Flooring tests**. Report of Forest Products Research Board, London 1951: 12-13.

Results of the preliminary experiments on moisture content and dimensional changes in strip floor samples of species including teak are presented.

4632 Garay, J.D.A; Duran, P.J.A; Moreno, P.P.A. 2001. **Particleboards from *Melina* and teak species**. (Spanish). Revista Forestal Venezolana 45(2): 205-212.

Boards made from Melina and teak were tested for its mechanical and physical properties. Static bending and tension perpendicular to the board surface tests determined the mechanical properties. The physical properties were evaluated by the thickness, dimensional stability and the water adsorption by water soaking tests.

4633 Limaye, V.D. 1941. **Wooden poles for overhead electric transmission**. Indian Forest Leaflet 8 (Utilization series).

The standard dimensions of wooden poles of different species including teak for different heights by strength classes are tabulated.

4634 Maung, U.W. 1956. **Teak dome building of the engineering college of the university of Rangoon, Burma**. Burmese Forester 6(1): 80-83.

4635 Mishra, H.N. 1997. **A case study on teak structure**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 205-207. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

The paper discusses the possibilities of rehabilitation of partially worn out teak structures of a prestigious building constructed about 200 years back using quality teak in roofs and floors. How the decay and deterioration of the left-over wooden components can be arrested and structural members renovated by incorporating timber engineering techniques have also been elaborated.

4636 Mishra, H.N. 1997. **Teak - the standard timber for structural use**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 199-202. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

The paper discusses the correct use of the costly timber, teak even in smaller forms

for bigger structures by joining them with modern fastening devices.

4637 Moore, D. 1962. **The utilization of hardwood (teak-*Tectona grandis* Linn.f.) thinnings in Trinidad and Tobago**. Eighth British Commonwealth Forestry Conference, East Africa, 1962. Government Printing Office, Trinidad: 5p.

4638 Munz, W. 1960. **Working teak**. (German). Verlag und Holzfachbuchdienst Holz, Merling b. Augsburg: 74p.

A practical manual intended for furniture manufacturers using teak.

4639 Myint, U Thein; Kyi, U Win. 1988. **The utilisation potential of teak tops and lops**. Burma, Forest Research Institute: 26p.

The paper dealt with the determination of waste of teak tops and lops left in the forest after extraction. It shows that about 31.5 percent of the tree was left in the forest.

4640 Nair, V.R.K. 1997. **Utilization aspects of teak**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 179-184. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Being light, strong and durable, teak wood is superior to every other kind of wood. Once seasoned, teak will not split, crack, shrink or warp. Teak grown under different climatic conditions exhibits differing qualities. The management of teak is tailored to suit its utilization aspects. The logging methods now employed require further improvements to reduce wastage to the minimum so as to obtain maximum quantity of timber and thereby obtain maximum of revenue. Though Kerala is one of the largest producers of teak in the country, it is beyond the means of the common man in Kerala to go in for teak for his use on account of its high price in the market.

4641 Namasivayam, M. 1965. **Making use of our forest resources**. Ceylon Today 14(7): 25-27; 32.

A general article on forest area and composition, timber potential, reforestation with teak and other species, economics and prospects including forest industries.

4642 Nanda, J.R; Krishnaswamy, K.R. 1968. **Indigenous woods for power transformers**. Electricity India 8(2): 31-35. Forest Research Institute, Dehra Dun.

Beech wood popularly used for distribution transformers, can be replaced by teak and other species as per studies conducted.

4643 Narayanamurti, D. 1948. **Note on treated wooden transmission poles in India**. Indian Forest Bulletin 140.

The bulletin deals with the selection, treatment, care etc. of wooden transmission poles. Teak is one of the species dealt and its relevant properties for use as transmission poles are presented.

4644 Olorunisola, A.O. 2003. **Teak production, processing and utilization in Nigeria**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Information on the current status of production, processing and utilization of teak in Nigeria is presented. Findings indicated that teak is plantation grown in the government owned forest reserves in Nigeria. About 70,000 ha. of teak plantation is now existing in Nigeria, which make the country the largest teak producing nation in Africa. Nigerian grown teak is moderately hard, strongly scented, dark golden yellow in colour when freshly cut and light brown when dry. It is commonly used in the country as furniture components, telegraphic poles, floor parquette production, fuelwood and charcoal making.

4645 Pruthi, K.S. 1997. **Prospects of conserving teak by using alternative species**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 191-198. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

There are many alternative species which are superior in strength and equivalent in durability with teak. Selection of correct species for structures would help to conserve teak for more important export-oriented purpose.

4646 Ross, P. 1958. **The utilisation of teak in Trinidad**. Caribbean Forester 19(3/4): 80-85.

Describes the Forest Department's initiations for utilizing thinnings from teak plantations, which include a fencing factory, sawmill and creosoting plant.

4647 Sangkul, S. 1995. **Processing and development technology and future: Trend for utilisation**. 2nd Regional Seminar on Teak, Yangon, Myanmar, FAO Document 9.

4648 Sangkul, S; Piam-a-roon, A; Laothai, P. 1992. **Lumber recovery of small size teak logs from thinning**. Proceedings of the Seminar on 50 Anniversary of Hyay-Tak Teak plantation, Bangkok, 5-8 August 1992.

Plantation grown teak logs of 2.50 m long with diameter ranging from 9-20.5cm harvested by selected crown-thinning practice from 20 year old trees of Maemai Plantation of Forest Industry Organization in Lampang province were cut by using through and through method. The average lumber recovery was 51.38 percent.

4649 Santhakumaran, L.N; Rao, K.S; Srinivasan, V.V. 1997. **Performance of teak in marine exposure trials in Indian waters and some aspects of its utilization**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 185-190. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Results of the performance of teak in marine exposure trials conducted at various localities along the Indian coast over the past few decades are examined with a view of providing suggestions for its proper utilization. Aspects covered include principal marine borers damaging teak, virulence of their attack and the resistance of teak to biodeterioration and the preservative treatment.

4650 Sekhar, A.C. 1960. **A note on some trends in teak utilisation in India**. FAO Sub-Commission, New Delhi FAO/TSC 60/4.12: 5p.

Some recent trends in utilisation, availability and indigenous production in India, together with market trends, uses and substitutes, grading and technological and research trends is discussed.

4651 Sekhar, A.C. 1962. **A note on some recent trends in teak utilization in India**. Journal Society of Indian Foresters 2(2): 29p.

Covers availability, market and trades trend, quality selection, seasoning, durability, strength, uses and substitutes in railway, structures, ship building and boat buildings, lorry body construction, agricultural implements, furniture, teak stock, grading, technological and research trends and physical and mechanical properties of teak in India.

4652 Soerjohadikoesoemo, D. 1970. **Influence of the methods of manufacturing sleepers for the Indonesian State Railways on prime costs and the prevention of waste**. Rimba Indonesia 15(3/4): 131-138.

A cost study showing economic savings in the production of teak sleepers by sawing as compared with the wasteful conventional method of manual hewing.

4653 Sutigno, P; Evans, P.D. 2002. **Effect of aqueous extraction of wood-wool on the properties of wood-wool cement board manufactured from teak (*Tectona grandis*)**. Wood Cement Composites in the Asia Pacific Region. Proceedings of a Workshop, Canberra, Australia, 10 December 2000: 24-28. Australian Centre for International Agricultural Research, Canberra, Australia.

Extractives in teak inhibit the setting of cement and reduce its suitability for the manufacture of wood cement composites. Aqueous extraction of wood wool is found a very effective method of increasing the suitability of teak for the manufacture of wood wool cement board.

4654 Trotter, H. 1940. **Manual of Indian forest utilization**. Oxford University Press, London: 360-363.

Along with descriptions of other Indian woods - their anatomical structure, properties and uses etc. of teak is dealt with on pages 360-363.

4655 Troup, R.S. 1909. **Indian woods and their uses**. Indian Forest memorandum 1(3). Forest Research Institute, Dehra Dun.

Gives notes on teak, its habitat, description, wood and principal uses.

4656 Troup, R.S. 1911. **Indian woods and their uses**. Government of India Press, Calcutta: p256.

4657 Vallil, G. 1997. **Utilization of teak**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 175-178. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

It is dealt with all aspects of utilisation of teak in India. To meet the increasing demand for teak wood and to bridge the gap between demand and supply, increased production and more efficient utilization are suggested.

4658 Vreeling, L. 1941. **Fences against wild animals in Ponorogo**. Tectona 34: 461-464.

Suitable fencing out of teak thinnings is made to protect agricultural crops from wild pigs.

4659 Woods, R.P. 1950. **Comparative decking experiments**. Review of Timber Development Association 2(10): 13-15.

Describes the experiments with ships decking laid on a New Zealand shipping company vessel, wherein teak and other timbers were used.

Go top

Wood Composites

4660 **Suitability of teak for veneers**. Indian Forester 54(1), 1928: 45-46.

Reports the use of teak for veneering and flooring planks and its use in USA for fancy cabins, pleasure boats and larger yachts, flooring and interior work of fine residences, club rooms and bank buildings.

4661 **Plywood and veneer in South Africa**. Industrial Reference Service of U.S, Department Communication 4 (Part 6, No.47), 1946: 3p.

Discusses imports for the period 1934-39 and impetus received to South African plywood industry and then decline observed since 1943. Species used include teak along with several other species.

4662 Badejo, S.O.O. 1989. **Influences of pre treatment temperature and additive concentration on the properties of cement bonded particleboard from plantation grown tropical hardwoods**. Tropical Science 29(4): 285-296.

Modulus of rupture and swelling properties of cement bonded particleboards, fabricated from three plantation grown tropical hardwoods including teak were evaluated using two pre treatment production variables of hot water temperature and additive concentration. Use of hot water at the higher temperature led to production of stronger, but less moisture resistant boards. Incorporation of aluminium sulfate into the panels resulted in stronger and more dimensionally stable boards.

4663 Beyse, R. 1991. **Production of teak wood is possible in Brazil too. A German veneer producer participates in a model forest enterprise in the tropical region**. Holz Zentralblatt 117(50): 785-786.

4664 Bhargava, P.N. 1955. **Examination of Indian cellulosic materials-woods, shrubs and herbs, (Central Province teak; Burma teak)**. Journal of Scientific Research, Banaras Hindu University 5(1): 149-154.

Forty different varieties of cellulosic materials commonly found growing fairly abundantly in trees, shrubs and herbs including teak have been examined from the physical, chemical and histological points of view.

4665 Chen, T.Y; Hwang, S.R. 1998. **Effect of wood species on the properties of cement-bonded wood particleboard**. Adhesive technology and bonded tropical wood products: 554-564. TFRI Extension Series 96. Taiwan Forestry Research Institute, Taipei, Taiwan.

Five native hardwood species of Taiwan were used in manufacturing cement-bonded wood particleboard. The compatibilities of hardwood species with portland cement were examined by measuring the setting time and compressive strength of wood particle portland cement mixtures. The mechanical properties of cement-bonded particleboard of *Tectona grandis* and *Albizia falcata* with three percent calcium chloride addition were found the best.

4666 Corne, M; Descos, J; Lucante, C; Roth Meyer, M. 1978. **The effect of veneers and finishings used in cabinet making on the flammability of fire-proofed panels**. (French). Courrier de l'Industriel du Bois et de l'Ameublement 2-78: 14p.

An investigation measuring the effect on the properties and fire classification of fire proofed particleboard of veneering with species including teak.

4667 Das, A; George, J. 1969. **Suitability of some Indian timbers for portland cement bonded woodwool boards**. Journal of Timber Development Association, India 15(2): 21-25.

Of fifty Indian wood examined for woodwool board manufacture teak was found to possess satisfactory strength properties absorption capacity of hydration heat of wood cement mixes.

4668 Dokania, L.N. 1973. **Export possibility of plywood from India**. IPIRI Journal 3(1): 3-6.

It is suggested that the plywood industry should be developed, with a view to exports, especially in the Andaman and Nicobar Islands and that the export of Rosewood and teak veneers should be undertaken.

4669 Elmendorf, A. 1967. **Some requirements of hardwood veneer flooring**. (German). Holz als Roh-und Werkstoff 25(1): 32-35.

Discusses the requirements, manufacture, installation, finishing and properties of hardwood veneer floor tiles.

4670 Forestry and Forest Products Research Institute, Japan. 1978. **Properties of some Papua New Guinea woods relating with manufacturing processes. IX. Plywood, particleboard, cementboard, pulp and charcoal from some West New Britain woods**. (Japanese). Forestry and Forest Products Research Institute, Japan, Bulletin 299: 151-187.

A description is given of the utilization of twenty three species including teak in several industrial processes, the problems associated with particular species and methods of reducing these problems.

4671 Fukuhara, Y; Komura, S; Suzuki, I. 1972. **On the penetration of light through wood veneer and the reflection on wood surface in hardwoods**. (Japanese). Bulletin of the Utsunomiya University Forests 9: 15-25.

The relative intensity of penetrating and reflected light was measured by two improved types of apparatus on hardwood veneers, mostly of *Zelkova serrata* and *Tectona grandis*.

4672 Gnanaharan, R; Dhamodaran, T.K. 1985. **Suitability of some tropical hardwoods for cement bonded wood wool board manufacture**. Holzforschung 39(6): 337-340.

Extracts of thirteen tropical hardwoods including teak in cold water, hot water and 0.5 NaOH solution were compared with those of *Pinus khasya* in relation to their inhibitory effect in cement setting. A knowledge of the pH of cold water, hot water and mild alkali extracts and the extent of acidity will help not only in screening suitable species for cement-bonded wood-wool board manufacture but also in choosing the suitable method of extraction.

4673 Gulati, A.S; Jain, J.D. 1980. **A note on the water absorption and swelling properties of commercial particle boards**. Indian Forester 106(6): 418-423.

Changes in length and width were all less than 0.5 percent of initial values after seven days. At least 50 percent of the changes in moisture content and thickness occurred in the first 24 h.

4674 Gupta, R.C; Jain, D.K. 1980. **Effect of resin treatment on the properties of veneers at various stages**. Indian Forester 106(10): 726-731.

Density, tensile strength, MOE and MOR were measured of 1.5-mm veneers of nine Indian species including teak at four stages of treatment with PF resin, viz. impregnated, impregnated and air dried, impregnated and cured and cured and water saturated.

4675 Hayashi, D; Tochigi, T; Inoue, H. 1970 . **Machinability of thin thickness veneers**. Wood Industry 25(12): 25-28.

A study illustrated with graphical data on the cutting of thin veneers from wood of species including *Tectona grandis*.

4676 Hwang, S.R; Chen, T.Y. 1992 . **Cement bonded wood particle boards - (I) Setting properties of the cement mixed with wood particles**. Forest Products Industries 11(4): 52-67. Harare, Zimbabwe.

Examined the compatibility of different wood species including teak particles with portland cement by setting time and compressive strength test.

4677 Indian Standards Institute, New Delhi. 1957. **Specifications for medium strength air craft plywood, IS: 809, 1957**. Indian Standards Institute, New Delhi .

Tectona grandis is a suitable species for manufacture of air craft plywood.

4678 Indian Standards Institute, New Delhi. 1957. **Specifications for marine-plywood IS: 710**. Indian Standards Institute, New Delhi .

Teak is a suitable species for manufacture of face veneers, core and cross-bands.

4679 Indian Standards Institute, New Delhi. 1958. **Timbers for decorative plywood IS: 1328**. Indian Standards Institute, New Delhi .

Tectona grandis is considered as a suitable species for manufacture of decorative plywood.

4680 Indian Standards Institute, New Delhi. 1960. **Specification for plywood for general pur-**

poses IS: 303. Indian Standards Institute, New Delhi .

Teak comes under class I list suitable for manufacture of plywood for general purpose.

4681 Indian Standards Institute, New Delhi. 1960. **Specification for block boards IS: 1959**. Indian Standards Institute, New Delhi .

Teak comes in class I list suitable for manufacture of block-boards.

4682 Indian Standards Institute, New Delhi. 1964. **Specifications for plywood tea-chests (Revised) IS: 10, 1964**. Indian Standards Institute, New Delhi .

Tectona grandis is found suitable for manufacture of plywood tea chests.

4683 Indian Standards Institution, New Delhi. 1988. **Specification for teak logs for production of sliced veneers**. Indian Standard 5248-1988. Indian Standards Institution, New Delhi.

4684 Jain, N.C. 1966. **Studies on peeling characteristics of Indian timbers-Part I**. Holzforschung und Holzverwertung 18(6): 108-109.

Preliminary tests were made at Dehra Dun with species including *Tectona grandis*. Veneer quality increased with decrease of cutting resistance.

4685 Jain, N.C. 1968. **Slicing characteristics of Indian timbers**. Holzforschung und Holzverwertung 20(3): 59-61.

Reports the effect of horizontal and vertical knife gap on veneer quality and uniformity of thickness in species including *Tectona grandis*.

4686 Jain, N.C (et al). 1968. **Peeling characteristics of Indian timbers. Part 4: *Tectona grandis* (teak)**. Holzforschung und Holzverwertung 20(4): 76-79.

Optimum conditions were found.

4687 Jain, N.C; Bist, B.S. 1971. **Comparison of strength properties of plywood from peeled and sliced veneers. Part I**. Indian Forester 97(8): p476.

Data are tabulated on glue adhesion, tensile strength, bending strength, panel shear strength and compressive strength for plywood made from peeled and sliced veneers of species which include *Tectona grandis*.

4688 Jain, N.C; Gupta, R.C. 1969. **A note on complete utilisation of trees**. Indian Forester 95(12): 841-848.

Gives results of work done at the Forest Research institute, Dehra Dun, on strength properties of *Tectona grandis*. Data are given for veneers, particle boards, fibreboards, plywood and boards obtained by thermal plasticization of leaves and of sawdust.

4689 Joesoef, M; Kasmudjo. 1979. **The manufacture of cement board from teak wood veneer waste**. (English; Indonesian). Duta Rimba 5(30): 14-23.

4690 Karnasudirdja, S. 1989. **Strength of glue laminated timber made from three wood species**. (Indonesian). Jurnal Penelitian Hasil Hutan 6(5): 281-287.

Data are presented on the bending strength, compressive strength and shear strength of solid and laminated samples of three species which include teak.

4691 Karnphanich, P. 1968. **Preliminary study on the particle board made from teak saw-dust with various quantity of lac**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The particle board made with twenty percent lac and sawdust of teak is better than particle board with 10 and 15 percent lac, except for water absorption percent. The nail holding capacity and modulus of rupture is lower than standard level.

4692 Kliwon, S; Memed, R; Iskandar, M.I. 1997. **Properties and utilization of teak wood for wood composite products**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 203-204. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

The paper discusses the research results on utilization and the properties of teak wood as a raw material for wood composite products, such as decorative veneer, particle board, and wood wool cement board.

4693 Kristnabamrung, W; Takamura, N. 1972. **Suitabilities of some Thai hardwoods and coconut-husk fibre for manufacturing hardboards by wet and dry processes**. Thai Journal of Agricultural Science 5: 101-125.

The hardwoods tested include *Tectona grandis*. *T. grandis* was found suitable for dry but not wet processing.

4694 Kumar, C.P.S; Bhatnagar, M.S. 1960. **Study of various cellulosic materials used as filler in molding powder II. Effect of particle size on the bulk density**. Indian Pulp and Paper 15: 325-327; 330.

Cellulosic materials used include that of teak wood.

4695 Kumar, V.B; Kohli, R.C. 1967. **Studies on surface spread of flame in particle boards**. Holzforschung und Holzverwertung 19(6): 115-117.

Thirty two kinds of board of Indian manufacture showed roughly linear decrease in flame spread with increasing density. Teak chipboard had the lowest flame spread.

4696 Lii, W.J; Liu, C.T. 1992. **The effect of repetitive loading on the properties of laminated wood**. Forest Products Industries 11(3): 34-44.

A study was made of the properties of common teak laminated wood with different lamina thickness and adhesives and their properties under repetitive loading.

4697 Liu, C.T; Lii, W.J. 1990. **Effect of physicochemical properties and gluing methods on the qualities of laminated wood made from fast-growing species (11). Studies on the fabrication of laminated wood from Taiwan red pine, Honduras mahogany and common teak**. (Chinese). Forest Products Industries 9(3): 11-22.

Bending strength was determined for laminated wood made with resorcinol formaldehyde, urea formaldehyde or polyvinyl acetate glue and wood of Taiwan which include teak.

4698 Liu, C.T; Lii, W.J. 1994. **The creep behaviour of laminated woods from fast-growing tree species under long-term loading (II) - effect of various species on the creep behavior of laminated wood**. Quarterly Journal of Chinese Forestry 27(1): 67-82.

4699 Liu, C.T; Lii, W.J. 1995. **The creep behaviors of laminated woods from fast-growing tree species under long-term loading. (III). The bending properties and creep behavior of end-to-end grain jointed laminated wood**. Quarterly Journal of Chinese Forestry 28(3): 117-131.

4700 Merrick, M.J; Knapp, A.B. 1968. **The bowing of panels: An interim report**. FIRA Technical Report Furn. Industrial Research Association, Stevenage 31: 34p.

Discusses the basic causes of bowing in veneered and other composite panels and examines in detail four case histories illustrating the principles involved which include of teak veneered wardrobe door.

4701 Nagle, W. 1934. **Testing of Indian timbers for veneer and plywood**. Indian Forest Records 20(14): 56p.

4702 Nagle, W. 1937. **Testing of Indian timbers for veneer and plywood**. Indian Forest Records (n.s.) Utilization 1(5): 115-141.

4703 Narayanamurti, D; Aswathanarayana, B.S. 1970. **Creep behaviour of materials from teak wood**. (German). Holztechnologie 11(2): 116-119.

The creep under bending load of solid teak and of plywood and laminated wood made from teak veneers was measured under constant climatic conditions.

4704 Narayanamurti, D; Gupta, R.C; Singh, J. 1962. **Measurements of swelling pressure on wood-based plastic boards**. Holz als Roh-und Werkstoff 20(3): 89-90.

The results of measurements of swelling pressure made on plastic boards from species including *Tectona grandis*.

4705 Narayanamurti, D; Jain, N.C; Singh, K. 1962. **Utilization of Rajasthan teak**. Research and Industry, New Delhi 7(3): 88-90.

Reports on a preliminary survey of the suitability of billets often crooked for making veneer, fibreboard and chipboard.

4706 Pound, J. 1965. **Laminated window frames**. Wood 30(6): 69-71.

Describes the technique of using R.F. heating to glue teak facings to softwood in the manufacture of parts for window frames.

4707 Prasad, B.N. 1957. **Chipboards from Indian timbers**. Research and Industry, New Delhi 2(11): 293-297.

Presents tabulated results of preliminary tests on physical and mechanical properties of boards from materials including *Tectona grandis*.

4708 Raghavendra, B.G; Nagaraju, S. 1976. **Optimizing the trim allowance in plywood manufacture**. IPIRI Journal 6(1): 1-9.

Appropriate data and calculations are given for the optimum trim allowance in a plywood mill in India producing decorative teak veneers.

4709 Raknes, E. 1963. **The gluing of teak**. (Norwegian). FIRA Bulletin Transl. Furn. Industrial Research Association, Stevenage 12.

A study of the gluability of teak with various adhesives.

4710 Ramamritham, S; Narasimhan, R. 1954. **Use of indigenous timber for development of air-craft quality plywood (teak)**. Composite Wood 1(6): 138-144.

Teak though a good structural timber does not appear to be quite suitable for use in aircraft quality plywood as the samples tested lacked in proper bending qualities and also had knots in veneers resulting in a weakening in the tensile and shear strength values.

4711 Sekhar, A.C; Jain, J.D. 1976. **A note on the physical and mechanical properties of commercial particleboards**. Journal of the Indian Academy of Wood Science 7(1): 25-30.

The properties of 6-, 13-, 19-, and 35-mm thick three-layered boards made from mixed hardwoods and of 19-mm thick boards made from teak were determined by various tests.

4712 Seth, V.K. 1974. **Prospects of veneering and plywood industries in Madhya Pradesh**. Indian Forester 100(10): 601-605.

The costs of establishing the veneering and plywood units, the volume of teak and miscellaneous timber required and the plywood output of the units are discussed.

4713 Sivananda, V. 1992. **The problems and prospects in producing plywood from small diameter logs**. National Conference - Standardisation and Quality Upgradation of Lignocellulosic Panel Products, New Delhi.

4714 Suh, J.S; Doh, G.H; Kim, S.K. 1989. **A study on the wood adhesion techniques for furniture use. (I). Properties of fancy veneer-overlaid panel**. (Korean). Research Reports of the Forestry Research Institute Seoul 39: 24-31.

Adhesion quality was tested for veneers made out of the species including teak which were glued onto 3, 6 or 9 mm-thick plywood, particleboard or fibreboard. Veneer shrinkage and abrasion resistance were in the order oak, elm, teak and paulownia.

4715 Tan, Y.E; Mohd Shukari Midon; Mohd Zaini Ujang. 1992. **Bonding quality as a means for assessing Malaysian timbers for structural glue-lamination**. Journal of Tropical Forest Science 4(4): 331-339.

Seven local timbers including teak were glued with phenol resorcinol formaldehyde adhesive and evaluated for both interior and exterior structural glue lamination based on their bonding quality.

4716 Wang, S.Y; Kuo, P.W. 1996. **Studies on the static frictional behaviours of wood based flooring materials**. Forest Products Industries 15(3): 369-390.

The frictional properties are studied of the flooring materials made out of the species including teak.

4717 Wang, S.Y; Lay, K.J. 1979. **Studies on the control and prevention of the surface checking of fancy plywood (II) Black walnut and teak fancy plywood**. (Chinese). National Taiwan University, Experimental Forest, Technical Bulletin 124: 103-128.

Tests of the effects of moisture content, various types and amounts of adhesives and impregnation with PEG.

4718 Wong, W.C; Wong, C.N. 1982 . **Stains on furniture with teak overlay**. Malaysian Forester 45(1): 94-100.

Stains are found to develop gradually on components made from plywood groundwork surfaced with decorative teak veneers resulting in their later rejection and financial loss.

4719 Yagishita, M; Okanishi, T. 1964. **Studies on surface checking in plywood. Report I**. Bulletin Forest Experiment Station, Meguro, Tokyo 167: 29-42.

Face veneers of nine species were bounded to nine plybases with the fibres parallel or at right angles to those of the next sheet. All species showed in increased checking under treatment, the main sites of checks being the interior or the vicinity of the rays, and vessels appearing at the surface, particularly those cut obliquely.

Go top

Fodder, Medicinal, etc.

(See also 0598, 0612)

4720 Anbarasu, C; Dutta, N; Sharma, K. 2001. **Use of leaf meal mixture as a protein supplement in the rations of goats fed wheat straw**. Animal Nutrition and Feed Technology 1(2): 113-123.

Determined the replacement value of *Leucaena leucocephala-Morus alba-Tectona grandis* in the ratio 2:1:1 leaf meal mixture as a nitrogen source in conventional supplements for female goats. Leaf meal mixture could be used as a supplement like oil cakes when wheat straw is limiting the nutrient intake of goats and the leaf meal mixture could contribute up to 20 percent of the total DM intake.

4721 Anbarasu, C; Dutta, N; Sharma, K; Rawat, M. 2004. **Response of goats to partial replacement of dietary protein by a leaf meal mixture containing *Leucaena leucocephala*, *Morus alba* and *Tectona grandis***. Small Ruminant Research 51(1): 47-56.

It is reported that *Leucaena leucocephala-Morus alba-Tectona grandis* (2:1:1) based leaf meal mixture can be used inexpensively as a vegetable protein supplement to wheat straw based diets for goats without any adverse effect on voluntary intake, nutrient utilization, serum enzymes and immune status.

4722 Beri, R.M; Karnik, M.G. 1965. **Teak oil from *Tectona grandis* Linn.f.** Current Science 34(2): p48.

Data are presented on the properties of the oil obtained by steam distillation of the wood.

4723 Bhuyan, R; Saikia, C.N; Das, K.K. 2004. **Commercially adoptable process for manufacturing natural dyes for cotton**. Natural Product Radiance 3(1): 6-11.

Dyes are extracted from the leaves of *Tectona grandis* and the dyeing behaviors of the colour components on cotton are evaluated.

4724 Chakraborty, M.K; Bhattacharjee, A. 2003. **Plants used for thatching purpose by the tribals of Purulia District, West Bengal, India**. Journal of Economic and Taxonomic Botany 27(3): 571-572.

This paper deals with 16 species of plants which include teak, used by the tribals of Purulia district of West Bengal for thatching purposes. The leaves of teak are used for thatching roofs.

4725 Chopra, R.N; Nayar, S.L; Chopra, I.C. 1956. **Glossary of Indian medicinal plants**. Council of Scientific and Industrial Research, New Delhi: 240p.

Includes medicinal properties, local names and distribution of teak.

4726 Chow, P; Lucas, E.B. 1988. **Fuel characteristics of selected four year old trees in Nigeria**. Wood and Fiber Science 20(4): 431-437.

Stems of four year old trees including *Tectona grandis* were collected from a fuelwood plantation in Ibadan and the fuelwood characteristics of the species are studied.

4727 Dimmel, D.R; Sklar, P.I; Crews, K.E; Pullman, G.S. 2000. **Pulping catalysts in trees**. Journal of Wood Chemistry and Technology 20(3): 225-242.

Several hardwood and softwood trees were analysed for anthraquinone-type components. The anthraquinones were more concentrated in the heartwood of teak than in the sapwood.

4728 Ebdon, P. 2003. **Processing technology for value added products of teak from small and medium sized entrepreneurs of developing countries**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

One of the problems faced by wood entrepreneurs is drying the timber prior to the manufacture of various items. In order to get quality products from teak , it is suggested that the workforce should understand the different aspects of drying and methods to measure moisture content of wood, temperature, humidity, etc. either by providing simple to read printed materials or organizing small workshops. The initiative taken up by the Timber and Forestry Department of Enterprises in 1996 was found successful and conducted similar concerns in different countries. It is suggested that the woodworkers need to be educated on the importance of timber drying for the manufacture of wood products of superior quality.

4729 Guha, S.R.D; Pant, P.C. 1964. **Pulping of plywood veneer waste**. Indian Pulp and Paper 19(6): 393-395.

Plywood veneer waste of species including teak alone or in mixtures, after digestion in $NaOH/Na_2S$ produces pulps for production of writing and printing papers.

4730 Guha, S.R.D; Singh, M.M; Saxena, V.B. 1961. **Chemical pulps for writing and printing papers from a mixture of broad leaved woods**. Indian Forester 87(7): 431-433.

Unbleached sulphate pulps in satisfactory yields and good strength properties useful for producing wrapping paper were produced from teak and other species.

4731 Guha, S.R.D; Singh, M.M; Saxena, V.B. 1961. **Chemical pulps from a mixture of broad-leaved woods**. Indian Forester 87(3): 194-197.

Unbleached sulphate pulps in satisfactory yields and good strength properties useful for producing wrapping paper were produced from teak and other species.

4732 Guha, S.R.D; Singh, M.M; Mathur, B.C. 1964. **Pilot plant production of wrapping and writing papers from a mixture of hardwoods**. Indian Forester 90(2): 755-757.

Experimental results on pilot plant scale indicated that mixtures containing species including *Tectona grandis* give pulps in satisfactory yields with good strength properties for production of wrapping and writing papers.

4733 Guha, S.R.D; Singh, M.M; Bhola, P.P. 1977. **Pulping of *Anogeissus* spp. and *Tectona grandis* (lops and tops) for newsprint**. Indian Forester 103(3): 196-202.

Optimum conditions of chemical concentration, sulphidity, temperature and time were found. Satisfactory newsprint was made by mixing *Anogeissus* or *Tectona* with 40 percent bamboo pulp.

4734 Gupta, R.S; Patle, B.R. 1993 . **Energy requirements of crossbred calves fed complete feeds based on poor quality roughages**. Indian Veterinary Journal 70(2): 148-151.

For crossbred cattle were given diets based on wheat straw or dry, fallen teak leaves as sole source of roughage for 28 days. The roughages were coarsely ground, treated with water and 4 percent urea and fed at 40 percent together with concentrate.

4735 Gupta, S; Uniyal, B.M. 2003. **Indian woods - their medicinal importance and identification**. Indian Forester 129(10): 1225-1239.

The article deals with the anatomy and medicinal value of the 25 Indian woods including teak that are well known for their medicinal properties and also useful timber. Images of transverse section have been added to show their gross structure.

4736 Gupta, V.C; Hussain, S.J; Imam, S. 1997. **Important folk-medicinal plants and traditional knowledge of tribals of Aurangabad and Nasik forest divisions of Maharashtra, India**. Hamdard Medicus 40(2): 59-61.

The forest types and products, geophysical characteristics and climate of Maharashtra are briefly described. The socio-economic status of the people and their herbal folk treatments for common ailments are briefly outlined. Fifteen plant species including teak used in such treatments are listed, in each case the scientific and common names, part of the plants used, mode of utilisation and name of the tribe who use the treatment is given.

4737 Haffner, L.C; Kobe, K.A. 1940. **Douglas Fir as a pulpwood**. Trade Journal 111(9): 93-98).

Young teak wood has little value as a raw material for paper-making owing to the short length of the fibres and to the difficulty in obtaining an easy-bleaching pulp.

4738 Hartoyo; Ando, Y; Roliadi, H. 1978. **Experiments on charcoal briquetting of five Indonesian wood species**. (Indonesian). Laporan, Lembaga Penelitian Hasil Hutan 103: 12p.

4739 Imperial Institute, London. 1940. **Young teak for paper making from Trinidad**. Bulletin Imperial Institute, London 38(3): 285-289.

4740 Jain, N.C; Singh, J. 1965. **Utilisation of tree leaves**. Paper Plastics 10(2): 18-19.

Suitability of the species including *Tectona grandis* leaves for use as filler extender in urea resins and for making plastic and particle boards was examined.

4741 Jain, S.K. 1969. **Medicinal plant lore of the tribals of Bastar**. Economic Botany 19(3): 236-250.

The oil is obtained by distillation of wood chips of *Tectona grandis* cure eczema and ringworm.

4742 Jauhari, M.B; Bhargava, R.L. 1976. **Mixed tropical hardwoods for pulping and papermaking**. IPPTA 13(4): 316-323.

Important variables that affect pulping quality in kraft semichemical pulping of mixed tropical hardwoods including teak are discussed. Chip size, cooking time, chemical consumption, pulp washing, pre-heating and disc refining are the variables noted.

4743 Kirtikar, K.R; Basu, B.D. 1933. **Indian medicinal plants Vol. III, 1924-26**.

Details of *Tectona grandis* - its habit of growth, botanical description, medical properties of various parts of the tree, distribution, local names etc.

4744 Komarayati, S; Ismanto, A; Angraeni, I. 1995. **Potential of forest plants producing traditional drugs**. Proceedings of the Second National Seminar and Workshop on Ethnobotany, Book 1 - Medicinal Plant, 1995.

Utilisation of traditional medicinal plants has been increasing recently. Some of these plants which grow well in teak forest of Java and used widely by Javanese.

4745 Krishna, S; Ramaswamy, S. 1930. **A note on the so-called teak oil**. Indian Forester 56(11): p483.

Products of destructive distillation of teak were given and crystalline compound quinone is isolated. The usual teak oil is identified as heavy tar product forming 10.6 percent of distillate.

4746 Kukde, R.J; Thakur, B.S; Mendhe, S.N. 1993. **Dried teak leaves as a source of fodder during scarcity**. Indian Veterinary Journal 70(11): 1069-1070.

Groups of bullocks were fed on diets containing conventional fodder (control), dried teak leaves and legume straw or teak leaves treated with urea. Bullocks did not maintain body weight when given teak leaves alone or with legume straw.

4747 Kukreti, D.P. 1930. **Timbers for bent wood furniture**. Journal of Timber Dryers' Preservation Association 4(3): 8-11.

Teak timber does not have good bending properties and it can be used for low curvature bends only.

4748 Kulkarni, L.B. 1909. **Drugs of Sirsi and Kappat hills**. Journal of the Bombay Natural History Society 19(3): p577.

Seeds of *Derris oblonga* well powdered and roasted with teak oil is a medicine for itching of skin.

4749 Masilungan, V.A, et al. 1959. **Screening of Philippine medicinal plants used in the treatment of tuberculosis for substance inhibitory to Mycobacterium tuberculosis-607**. Philippine Journal of Science 88(2): 245-251.

The species having marked antagonistic effect include *Tectona grandis*.

4750 Patle, B.R; Gupta, R.S; Teckchandani, C.K. 1990. **Development of a feed processing unit for preparing complete feed pellets based on dry fallen teak leaves for growing calves**. Indian Journal of Animal Nutrition 7(3): 185-190.

A complete processing unit consisting of leaf collector, grinder and a pellet mill was developed for the preparation of complete feed pellets based on dry fallen teak leaves. The nutritive value of these complete feed pellets is also reported.

4751 Puntambekar, S.V; Krishna, S. 1933. **Oil from the seeds of *Tectona grandis***. Journal of Indian Chemical Society 10: 401-403. Forest Research Institute, Dehra Dun.

Teak seeds - after crushing fruits and extraction with ether gave a bright red oil.

4752 Rai, P.A; Jaspal, N.S. 1976. **Mixed pulping of bamboo and hardwoods**. IPPTA 13(4): 328-339.

Kraft pulps were made from mixtures of bamboo and Indian hardwoods including teak.

4753 Reddy, G.V.N; Reddy, M.R. 1986. **Effect of ammoniation on the utilization of sawdust as sole source of roughage in complete pelleted diets for crossbred cattle**. Indian Journal of Animal Sciences 56(2): 248-253.

4754 Reddy, V.A; Reddy, M.R. 1984. **Utilization of fallen dry teak leaves (*Tectona grandis*) as roughage source in complete pelleted rations of sheep**. Indian Journal of Animal Sciences 54(9): 843-848.

Dry fallen teak leaves replaced 0, 25, 50 and 100 percent of dry mixed grass, mainly *Sehima nervosum* and *Heteropogon contortus*, in complete pelleted rations of sheep. It was suggested that dry teak leaves can be used to feed sheep.

4755 Sangat Roemantyo, H. 1990. **Ethnobotany of the Javanese incense**. Economic Botany 44(3): 413-416.

Notes are given on types of incense, plant and other materials used in incense, making of incense and ritual uses in Java. It is reported that sawdust of *Tectona grandis* can be used for making incense.

4756 Sharma, S.K. 1999. **Plants used as henna dye by Bhils of southern Rajasthan**. Journal of Economic and Taxonomic Botany 23(2): p257.

Plants used as a substitute for leaves of *Lawsonia inermis* by Bhils in Rajasthan include buds of *Tectona grandis*.

4757 Soni, P.L; Pal, R; Madan, R.N. 1980. **Utilisation of teak bark - Production of pulp for wrapping paper and cellulose derivatives**. Holzforschung und Holzverwertung 32(2): 46-48.

Analytical data are given for teak bark and for sulphate pulp made from it. The yield and strength properties of the pulp indicate that it could be used for low grade wrapping paper or for production of cellulose derivatives.

4758 Sood, V.K. 1974. **Indian essential oils: Review of work at Forest Research Institute**. Indian Forester 100(4): 259-264.

Essential oils from twenty two species including teak wood are reported.

4759 Spoon, W. 1944. **Barrels made of Indian wood**. Hout. 24(4): 17p.

Teak in Java makes good casks for shipping liquids.

4760 Tiwari, D.P; Baghel, R.P.S; Patle, B.R. 1987. **Use of dry fallen teak (*Tectona grandis*) leaves as roughage in complete feed for cross-bred calves**. Indian Journal of Animal Nutrition 4(3): 214-216.

Dry fallen teak leaves were included in complete diets for calves. Teak leaves intake, body weight gain and digestibility, crude protein, ether extract, crude fibre and nitrogen-free extract were lower in calves given DFTL. It was concluded that DFTL could not replace wheat straw without reducing its nutritive value.

4761 Triratana, S; Osathaphant, P. 1988. **The cultivation of shiitake (*Lentinus edodes*) in sawdust substrates from different trees and agricultural wastes**. Journal of Agricultural Research and Extension, Thailand 5(3): 122-133.

The growth and yield of shiitake cultivated in 16 combinations of different sawdust from tropical trees and some agricultural wastes were investigated. The substrates tested include teak sawdust.

4762 Watt, G. 1893. **A dictionary of economic products of India 1889-93 Vol. I-VI, Part IV**. Government of India Press.

Gives notes on teak and its resin, dye, oils, medicine, etc.

Go top

International Forest Policy

4763 Banerji, J. 1952. **International Teak Commission**. FAO/Asia Pacific Forest Commission, 2nd session of the Forestry and Forest Products Commission for the Asia and Pacific, Singapore FAO/APFC-52: 15p.

Teak is the most important timber and its continued and ever-increasing yield can be maintained when satisfactory artificial and natural regeneration methods are evolved. Proper logging, grading and marketing will redound to economy, usefulness and greater supply of timber. The author recommends constitution of an International Sub-commission with headquarters at Dehra Dun.

4764 Becking, W. 1930. **Water-transport: Official meeting of Teak Department with debate**. (Indonesian; English). Tectona 30: 1065-1074.

4765 Buchy, M. 1996. **Teak and arecanut: Colonial state, forest and people in the Western Ghats (South India) 1800-1947**. Publications du Departement de Sciences Sociales No 2: 255p. Indira Gandhi National Centre for the Arts, Institut Francais de Pondichery, Pondichery.

This book is an historical study of the destructive nature of colonial exploitation in North Canara in the Western Ghats of Karnataka.

4766 Duyfjes, J.J. 1915. **Some examples about the progress of Government teak wood policy in 1914**. (Dutch). Tectona 8: 123-124.

4767 FAO. 1952. **International teak commission: Comments by Indonesia**. FAO/Asia-Pacific Forestry Commission 72: 7p.

Notes on silviculture of teak plantations in Indonesia is given.

4768 FAO. 1955. **Forestry Agency Japan: Teak in Formosa, (Tropical silviculture)**. Proceedings of FAO/Asia-Pacific Forestry Commission FAO/APFC-55/53: 7p.

4769 FAO. 1955. **Japanese Government: Teak general situation in Japan**. Proceedings of Asia-Pacific Forestry Commission FAO/APEF-55/63.

4770 FAO. 1960. **Report of the third session of the teak sub-commission, New-Delhi, India, 8-10 February 1960**. FAO Teak Sub-Commission, New Delhi FAO/TSC-60/8/1 and FAO/APEC-60/10 a.1: 19p.

Reports on the 3rd session and recommendations are made mainly on teak bibliography, teak grown under exotic conditions, provenance trials, mensuration, increment and yield, girdling of teak, physical, chemical and mechanical properties of teak and country reports of progress in teak forestry are given. Details of silviculture, management, research, production, trade and prices, teak grading rules and other topics like multi-lingual terminology etc. are given.

4771 FAO. 1967. **History and achievements of the teak sub-commission**. FAO/Asia-Pacific and African Forestry Commission, Teak Sub-Commission, Fourth Session, Rome FO:T-67/2: 4p.

The history of establishment of Teak sub-commission and recommendations of its previous sessions are reviewed and achievements of TSC on bibliography, ecology and races, seed-races and silviculture and management inventories, trade, utilization, information and documentation etc. are reviewed and items are suggested for consideration for further work.

4772 Gartner, C. 1956. **National progress reports to the sub-commission on teak: Indonesia**. Teak Sub-Commission, Bangkok FAO/TSC-56/25: 59p.

Reports on ecology, seed problems, silviculture, management, utilisation and trade of teak are covered.

4773 Huguet, L. 1958. **Forest policy and its execution-report to the Government of Cuba**. FAO/EPTA-Report 876. FAO, Rome.

Report deals with introduction of teak in Cuba.

4774 Keogh, R.M. 2002. **Teak 21: A support mechanism for high-grade tropical hardwoods**. International Forestry Review 4(3): 239-243.

This paper outlines the extent of the crisis of the sustained supply of high grade tropical hardwoods and introduces a working solution to the problem.

4775 Kerala Forest Department. 1990. **Administration report of Kerala Forest Department 1988-89**. Kerala Forest Department, Trivandrum.

4776 Kunhi Krishnan, K.V. 1997. **Colonial state and the Malabar teak**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 222-225. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Studies on the historical roots of the problem of deforestation, to identify the interests behind the formulation and implementation of forestry policies, to trace the evolution of British colonial forest policy, and to analyse it as part of the socio-political system are covered.

4777 Nair, K.K. 1997. **A teak research institute in 1991 - the year of teak**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 212-215. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Teak plantations have been raised for 150 years and natural teak forests have been scientifically managed. Development of appropriate technique for natural regeneration in mature plantations, systematic collection and utilization of seeds from genetically improved seed stands, establishment and proper management of seed provenance, development of improved thinning methods in plantations and natural stands, genetic improvement of tree for desirable morphological traits, effective control measures against defoliators and stem borers, *Loranthus*, fire, animal injury, etc., proper soil conservation measures against deterioration of sites under teak monoculture, evolving suitable species of mixture and planting technique, etc. are required for proper management.

4778 Saleh, W; Nadiar, S. 1991. **The role of Perum Perhutani in increasing of the social welfare on surrounding forest area**. Forest Magazine of Perum Perhutani, Jakarta (133/134).

4779 Shanmuganathan, K. 1997. **Nilambur teak - the history and a resume of early planting activities**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 226-231. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Nilambur forests is world famous for its plantation teak - Malabar teak. The efforts of the pioneers in teak planting are dealt with in this paper.

4780 TEAKNET. 1995. **TEAKNET: Asia-Pacific Region**. 16p. TEAKNET, Forest Department, Ministry of Forestry, Yangon, Myanmar.

The booklet describes the background, objectives, proposed activities, structure and resources for TEAKNET, a network to strengthen interaction among all those concerned with the conservation and sustainable management of teak bearing forests and plantations. Aims to facilitate exchange of technology and information on tree improvement, silviculture, management, harvesting, processing and trade of teak; assist in the exchange of genetic material, plants and wood samples, and standardize trials and methods which will enable international comparison; and promote collaborative studies on critical areas that are of common interest to member countries or institutes.

4781 Wirjodarmodjo, H; Soeroso, R. 1978. **History of Perum Perhutani**. (English; Indonesian). Proceedings of the 8th World Forestry Congress, Jakarta, October 1978. Duta-Rimba 4(26): 3-9.

This public enterprise was established in 1972 as a reorganization of existing state forest enterprises in Central and E. Java. Its history is traced back to the commercial enterprise Djatibedrijf set up by the Dutch administration in 1929 for the efficient production of teak in state forests. Its operations include processing and marketing of forest products.

Go top

CONTENTS

The subject is covered under the following headings. It is possible to branch to particular topics in the hard copy document enclosed.

Top
Bibliography
- General
- Country Reports
- Environmental Factors
- Site Factors
- Undergrowth
- Animals and Birds
- Soil Properties
- Litter Decomposition
- Soil Microorganisms
- Soil and Water Conservation
- Plant Botany
- Plant Chemistry
- Plant Physiology
- Plant Embryology
- Plant Morphology, Anatomy and Histology
- Dendroclimatology
- Genetics and Breeding
- Plant Pollination
- Genetic Improvement
- Ecology and Distribution
- Vegetation Ecology
- Silviculture
    - Regeneration and Formation of Stands
    - Seed Collection, Storage and Germination
    - Nursery Practices
    - Vegetative Propagation and Tissue Culture
    - Plantation Establishment
    - Plantation Techniques and Management
    - Field Trials
    - Fertilizer Trials
- Agroforestry
- Harvesting
- Injuries and Protection
    - Drought, Pollution and Stress
    - Forest Fire
    - Damage by Plants, Weeds and Control
    - Damage by Animals
    - Fungi and Bacteria

- Insect Pests
  - Biological Control
  - Chemical Control
- Surveying and Mapping
- Growth and Yield
- Productivity
- Management
- Marketing
- Wood Industry
- Wood Properties
  - Wood structure and Properties
  - Physical and mechanical properties
  - Chemical Properties
  - Wood Working Properties
  - Thermal Properties
  - Natural Durability
  - Preservative Treatments
  - Wood Grading
- Wood Utilisation
  - Wood Composites
  - Fodder, Medicinal, etc.
- International Forest Policy

Author Index

Subject Index

Go top

General

0001 Chand Basha, S; Mohanan, C; Sankar, S (Eds). 1997. **Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991**. Kerala Forest Department, Trivandrum and Kerala Forest Research Institute, Peechi: 274p.

This book contains over 50 papers presented at the conference. A keynote address by Dr. Y.S Rao, outlines the importance of teak both within its natural distribution area (India, Myanmar, Thailand and Laos) and in locations where it has been established as an exotic plantation species (tropical West Africa, Bangladesh, Malaysia, Indonesia, Central America and the Caribbean).

0002 Forest Research Institute, Dehra Dun. 1959. **Proceedings of All India teak study tour and symposium, December 1957 - January 1958**. Forest Research Institute, Dehra Dun: 196p.

The papers are on different aspects of teak such as silviculture and management of teak forests of Madhya Pradesh, Bombay, Mysore, Madras, W. Bengal, Rajasthan, Burma and Andhra Pradesh, regeneration, thinning, soils, ecology, coppicing, plantations of Konni, Nilambur and Kurseong Forest division.

0003 FORSPA, Bangkok. 1993. **Teak in Asia**. Proceedings of the China/ESCAP/FAO Regional Seminar on Research and Development of Teak, Guangzhou, China, 19-27 March 1991. H. Wood, Ed. FORSPA Publication, Bangkok: 126p.

Fourteen papers covering various aspects of silviculture research on teak in various Asian countries such as Bangladesh, China, India, Indonesia, Laos, Myanmar, Philippines, Sri Lanka, Thailand, Vietnam and genetic improvement works, planting techniques, storage techniques and growth pattern are included.

0004 Hulster, I.A de. 1972**. A note on *Tectona grandis*. Linn.f. (Verbenaceae).** 21p.

The climate and type of occurrence, soils, botanical characteristics including wood properties, exploitation, fruiting and germination, natural regeneration, coppicing and taungya cultivation, mixtures in teak plantations, thinnings, yields, protection against pests, fungi, diseases and insects affecting teak are generally discussed.

0005 Karunakaran, C.K. 1995. **Thekk (teak). Rev. Ed**. (Malayalam). State Institute of Languages, Thiruvananthapuram: 198p.

A general account of the qualities of teak timber, genetic improvement programmes, silviculture, pests and diseases, etc. is given. A short history of teak plantation establishment in Kerala is also given.

0006 Kerala Forest Research Institute, Peechi. 1995. **Teak (*Tectona grandis*)**. KFRI Information Bulletin 13. Kerala Forest Research Institute, Peechi: 8p.

A general account of distribution, habit and habitat, cultivation and management, nursery practices, stump preparation and field planting, intercropping, weeding, thinning, pests and diseases, wood properties, utilisation and yield of teak is given.

0007 Kerala Forest Research Institute, Peechi. 1996. **Teak (*Tectona grandis*)**. (Malayalam). KFRI Information Bulletin 14. Kerala Forest Research Institute, Peechi: 8p.

Describes distribution, habit and habitat, cultivation and management, nursery practices, intercropping, weeding, pests and diseases, wood properties, utilization etc. in general.

0008 Krishna Murthy, A.V.R.G. 1974. **A bibliography on teak, *Tectona grandis* Linn.f.** Jugal Kishore & Co., Dehra Dun: 402p.

A survey of the world literature covering about 2961 references with abstracts to the more important ones. Abstracts are arranged alphabetically by author.

0009 Mathur, K.B.L. 1973. **Teak bibliography. Titles with abstracts of important ones, of world literature dealing with *Tectona grandis* Linn.f.** Delhi, Manager of Publications: 320p.

References are arranged chronologically, to literature published from 1829 to 1970. There are indexes to authors and subjects.

0010 Moldenke, H.N. 1954. **Additional notes on the genus Tectona I and II**. Phytologia 5(3/4): 112-120.

I. Literature citations, synonymy, nomenclature and general notes on the genus *Tectona* and the species *T. grandis*. II. Literature citations and synonymy relating to *T. grandis*, *T. grandis* f. *abludens*, *T. grandis* var. *glabrifolia*, *T. hamiltoniana* and *T. philippinensis*.

0011 Pandey, D; Brown, C. 2000. **Teak: A global overview**. Unasylva 51(201): 3-13.

An overview of ecology, management of natural forests, history, areas and planting rates, management, productivity and volume estimates of plantations, roundwood production and trade, policies and legislation affecting teak management, production and trade and environmental issues of teak is presented.

0012 Pankaj Khullar (Ed). 1995. **Focus on teak**. Indian Forester 121(6): 445-589.

Twenty-one papers are included in this special issue which covers various aspects of teak, silviculture, growth, management, economics, pests and diseases, and wood properties and uses.

0013 Rao, Y.S. 1991. **Key note address at the International Teak Symposium, Trivandrum, December 1991**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi: 1-6.

Aspects of geographical distribution, growing conditions, regeneration, breeding and teak improvement, processing and marketing of teak are covered.

0014 Tajuddin, E; Anoop, E.V; Jacob, S. 1996. **Teak**. Kerala Agricultural University, Trichur: 59p.

A short account of distribution, climate and ecology, phenology, silviculture, regeneration, insect pests and diseases, tree improvement, properties and utilisation, and yield and marketing of teak is given. A short account of teak in Kerala is also given.

0015 Tewari, D.N. 1992. **A monograph on teak (*Tectona grandis* Linn.f.)**. International Book Distributors, Dehra Dun: 479p.

This monograph presents comprehensive information on *Tectona grandis*, with particular reference to India. Chapters on distribution, morphology, anatomy, silviculture and management, ecology, biomass and nutrient dynamics, genetic improvement, growth and yield, marketing and trade, utilization; non-wood products; diseases, insect pests, pest management and general bibliography on teak are included. A subject index is also provided.

0016 United Nations Economic and Social Commission for Asia and the Pacific, Bangkok. 1991. **Report of the regional seminar on research and development of teak, Guangzhou and Hainan Province, China, 19-27 March 1991**. United Nations Economic and Social Commission for Asia and the Pacific, Agricultural Requisites Scheme for Asia and the Pacific, Bangkok: 22p.

Topics discussed at the seminar included the natural distribution, silviculture and management of teak forests, artificial regeneration of teak, processing, utilization and marketing of teak and a proposal on Asian regional cooperation involving the setting up of a network (TEAK-NET).

0017 White, K.J. 1991. **Teak: Some aspects of research and development**. RAPA Publication 17. FAO Regional Office for Asia and the Pacific, Bangkok: 70p.

Part one describes silvicultural characters of teak, distribution, timber and non-timber uses, teak as an exotic and environmental impact. Part two covers regeneration and silviculture, artificial regeneration, mensuration and teak research priorities.

0018 White, K.J. 1993. **A selection of annotated references of teak (*Tectona grandis* Linn. f.)**. Forestry Research Support Programme for Asia and the Pacific, Occasional Paper 19. FORSPA Secretariat, FAO Regional Office for Asia and the Pacific, Bangkok: 22p.

The abstracts are arranged under 13 subject headings: provenance trials, selection criteria for superior phenotypes, improved seed strategy, phenology, flowering and pollination processes, stimulating fruit production in seed orchards, germination of teak, vegetative reproduction - tissue culture, insect pests of teak and their control, diseases of teak, forest plantation management practices, utilisation of plantation grown timber and environmental impact of plantations.

0019 White, K.J. 1993. **Research results: A selection of annotated references of teak (*Tectona grandis* Linn.f.).** Occasional Paper 19. FAO, Bangkok: 22p.

Selected annotated references related to the major areas of priority identified research in plantation management such as provenance trials, selection criteria for superior phenotypes, improved seed supply strategy, phenology, flowering and pollination, etc. are included.

Go top

Country Reports

(See also 2133)

0020 Amatya, S.M. 2003. **Role of teak (*Tectona grandis*) in conserving biodiversity in Nepal**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

It is indicated that teak is not the preferred species for large scale plantations in Nepal. One of the reasons for this is the site requirements. Despite the promising growth of teak in some areas, it suppresses the undergrowth, not enriching species diversity. In Nepal, farmers and communities prefer multi-purpose tree species because of the long rotation period of teak.

0021 Andrade Countinho, Sylvio de. 2003. **Teak in Brazil: Plantations, know-how, expertise and market overview**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Describes the actual situation of teak plantations in Brazil, the technologies used in order to improve its productivity and local market development for first and second thinning teakwood. The advanced expertise in reforestations, the availability of fertile soils and manpower will make Brazil an important player in the teakwood market. A Brazilian and Dutch capital company founded in 1994, named Floresteca, is the largest teakwood investment in Brazil, managing over 14,000 hectares of teak plantations.

0022 Apichart Kaosa ard. 1992. **Teak in Thailand**. Teak in Asia. Proceedings of the ESCAP/ FAO Regional Seminar on Research and Development of Teak, Guangzhou, China, 19-27 March 1991. Technical Document GCP/RAS/134/ASB.FAO, Bangkok: 79-85. FORSPA Publication.

The cost of stump production by using the tissue culture method is 2-3 times higher than that of routine stumps. Tissue culture of teak was intensively studied in Thailand. The experience showed that teak can be successfully propagated using shoot/tip and/or nodal segment cultures.

0023 Ariyadasa, K.P. 2003. **Teak in Sri Lanka: Resource base, issues and challenges**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Teak is the most popular species used in reforestation programs in Sri Lanka. Development of commercial teak plantations has been the responsibility of Forest Department until recently. Current National Forest Policy of the country has provided the policy and legal frame work conducive to large scale private sector investment in forest plantation development. Apart from commercial teak plantations, home gardens play a major role in supplying teak to the domestic market.

0024 Banik, R.L. 1993. **Teak in Bangladesh**. Teak in Asia. Proceedings of the China / Escap / FAO Regional Seminar on Research and Development of Teak. H. Wood, Ed. FAO, Bangkok: 1-10.

0025 Behaghel, I. 1999. **The state of teak (*Tectona grandis*) plantations worldwide**. (French). Bois et Forests des Tropiques 262: 6-18.

An analysis is presented of teak plantations worldwide which include summary tables showing extent by country and by forest type. Extensive natural forests of Myanmar, India, Laos and Thailand are shown. Short reports are included of all countries where teak has been introduced as a plantation species. Teak plantations cover almost 3 million ha in the world, in more than 50 countries. Asia accounts for 90 percent of these plantations, including countries such as Sri Lanka, Bangladesh, Philippines and Vietnam.

0026 Cardoso, J.G Alfaro. 1952. **Report on Mozambique (P.E.A.)**. (French). Proceedings of the 1st Conference of Forestry Inter African Countries, Abidjan, 1951: 546-550.

Two thirds of the country is under forest. The situation of scarcity of timber has been created since the end of the war by the great expansion in timber operations. Trees planted which include teak.

0027 Chapuis, P. 1990. **Twenty years of forestry research in Cuba**. (French). Bois et Forests des Tropiques 223: 43-50.

A brief overview of the work of the Institute of Forestry Research in Cuba between 1969 and 1989, including species trials and tree breeding programmes for tropical broadleaved species including teak.

0028 Dilip Kumar, P.J. 2003. **Teak in Karnataka state, India**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Teak occurs mainly in mixture with other hardwood timbers in the mixed moist and dry deciduous forests, mostly in the Western Ghats. Teak plantation was a high priority in the forestry operations. Some 146367 hectares raised up to December 2001 in the state. The practice of clear felling have been discouraged and given up by the mid '80s.

0029 FAO. 1956. **Country reports on teak**. First Session, Teak Sub-Commission, Bangkok, 9-18 February 1956. FAO, Rome.

A review of progress reports on teak forestry at national level from Burma, Dahomey, Togo, France, India, Indonesia, Japan, Laos and Thailand dealt with silviculture, ecology, seed problems, forest protection, forest management and forest utilization of teak.

0030 Heringa, P.K. 1946. **Notes on forests and forestry in Java from December 1941 to April 1946**. (Dutch). Tectona 36(1): 8-18.

Teak fellings in Java in 1942 and 1943 were 50 and 100 per cent. higher than the normal permissible cut. In 1944 almost all teak over 80 years old was girdled, as well as that 40-80 years old in some forest districts of central Java. Much damage was done in the woods through theft, timber sheds and houses were also broken down and robbed. Almost all Dutch forest officers were interned and replaced by Indonesians, and revision of working plans stopped.

0031 Howard, S.H. 1946. **The forest situation and its problems in India**. For. Quebec. 11: 61-67.

The forest domain of the Government of British India is about 100,000 sq. miles out of a total area of 800,000 sq. miles, or more precisely 13 per cent. There are also nearly 50,000 sq. miles of private forest. The essential points of the Government's forest policy are summed up. It is believed that it will be possible to meet increasing urban consumption by an increase in production. The best stocked forests will not be exploited for another 20 years. A great part of these evils could be avoided by the restoration of the ancient forests. Plans for restoration are suggested.

0032 Htwe, U.M.M. 2000. **Teak plantations in Myanmar**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 83-98. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

The Forest Department formulated a special 40-year Teak Plantation Program based on previous experiences and according to international guidelines and conceptual frameworks. Tree improvement programmes of Myanmar Forest Department are discussed. Planting and post planting practices, site management, silvicultural treatments and plant protection measures for the country are also discussed. Certain recommendations are made for successful plantation management in the country.

0033 Hussain, S. 1959. **Teak in Mysore**. Proceedings of All India Teak Study Tour and Symposium, December 57-January 58, Forest Research Institute, Dehra Dun, 1959: 76-79; 159-163.

Describes teak in Mysore state with its occurrence, geology, soils, climate, system of management, principal silvicultural characteristics, method of exploitation, natural regeneration, artificial regeneration, plantation techniques, cultural operations, control burning etc. Teak cultivation methods, agrisilviculture, rab-planting etc., and research on thinnings and planting under-taken in the state are also discussed.

0034 Kala, J.C; Kumaravelu, G; Krishnakumar, N. 2003. **Status report of teak in Tamil Nadu**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December

2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Discussed the various studies going on in the state which include teak improvement works, pre treatment methods of seeds, inducing flowering in teak clonal seed orchard, drip irrigation, establishment of clonal teak plot.

0035 Katwal, R.P.S. 2003. **Teak in India: Status, prospects and perspectives**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Teak is a celebrated timber of tropics and India is one of the major teak growing and utilizing countries. Domestication through plantations for one and a half centuries has made teak the most widely planted and researched tropical hardwoods. Significant development has taken place in standardizing plantation techniques, perfecting harvesting and post-harvest utilization methods and tree improvement. Teak resources of the world need immediate attention for their sustainable management.

0036 Kijker, S. 2003. **Teak in Thailand**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Natural teak forests in Thailand decreased from 2,324,300 ha in 1954 to about 1,50,000 ha in 2000, mostly due to the demand for agricultural land and constructional wood by the increasing human population. Up to 2000, both private and public sectors in Thailand could establish only 8,36,000 ha of teak plantations, as reported by FAO. Thailand has to import natural teak wood from overseas, especially from Myanmar, Lao P.D.R. and Indonesia, on an average of about 2 billion Baht annually. Information on teak improvement, research and development programmes in the country is discussed and pointed out the constraints in teak plantation establishment.

0037 Krishnapillay, B; Razak, M.A.A; Ong, T.H. 2003. **Growing teak in Malaysia**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

This paper attempts to look at the state of teak plantations in Malaysia and the research and other efforts that has been carried out to date to support establishment of teak plantations in the country.

0038 Kumaravelu, G. 1993. **Teak in India**. Teak in Asia. Proceedings of the China/Escap/FAO Regional Seminar on Research and Development of Teak: 1-10. FAO, Bangkok

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0039 Lamb, A.F.A. 1954. **Teak**. General Paper 4th World Forestry Congress: 18p. Forest Research Institute, Dehra Dun.

The teak plantations of Trinidad are described, along with site factors, silviculture, injuries and protection volume and yield data, and the need for future reserch on teak is stressed.

0040 Ma, H.M; Liang, K.N; Zhou, Z.Z. 2003. **Research and development of teak in China**. Forest Research 16(6): 768-773.

An overview of recent teak research on introduction and domestication, culture regionalization, seed treatment, production and storage of seedlings and silviculture in China is presented. The developmental prospects and research direction of teak in China are also presented.

0041 Morehead, F.T. 1944 . **The forests of Burma**. Burma Pamphlets 5: 67p. Longmans, London.

A condensed account of the essential facts about the forests of Burma, their organization and exploitation. It includes topography and climate, forest trees classified according to Troup's silviculture of Indian trees, forest fauna, and particularly the life history of the elephant, a history of the development of forestry, administration, policy, legislation, organization, research, etc., exploitation by Government agency and by lessees, methods of extraction, uses and markets and minor forest products.

0042 Nagesh Prabhu, H. 2003. **Teak in Kerala - past, present and future**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Ja-

pan; Ministry of Environment and Forests, New Delhi; IUFRO.

Discusses the present and future management and marketing aspects of teak. Teak was first raised on plantation scale in Kerala during 1842. After that Kerala Forest Department has raised large extent of teak plantations. As on today state forest department manages 74,872 ha. of teak plantations and on an average 1000 ha. teak plantation is being felled and regenerated each year. After the first plantation raised in 1842 by direct sowing/planting natural seedlings and stump planting introduced by T.F. Bourdillon during 1891, to improve the productivity of 2nd and 3rd rotation teak soils, using quality nursery stock, KFD has introduced root-trainer technology. Now KFD is attempting to raise clonal teak plantations utilizing 30 clones developed by KFRI.

0043 Nghia, C.Q. 2000. **Teak (*Tectona grandis*) plantations in Vietnam**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 99-108. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

There is no natural teak stands in Vietnam. The Ministry of Forests intends to plant teak on 10,000 ha each year to reach a total area of about 0.5 million by 2030. Teak plantations in the country are managed by the state through the State Forest Enterprises, forestry companies and the Forest Seed Production Centre. Tree improvement programmes, plantation establishment, site preparation, silvicultural practices and the financial analysis of plantation management are discussed in this paper.

0044 Oteng-Amoako, A.A; Sarfo, D. 2003. **Development of teak plantations in Ghana - propagation, processing, utilization and marketing**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

The development of teak plantation in Ghana is traced from 1875 when a German missionary first introduced it to the present Volta Region of Ghana. The success of teak plantations in Ghana is dependant upon many factors including its ease of cultivation, fast growth, resistant to fire, tolerance to range of soils and rainfall and superior wood and working qualities. The new collaborative research programme with four other partner countries funded by the European Community, will improve the quality and productivity of future teak plantations in Ghana and West Africa sub region.

0045 Ramnarine, S; Jhilmit, S. 2003. **Teak in Trinidad and Tobago**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Teak was introduced into Trinidad in 1913 from Myanmar. Plantations were established give a total teak estate of some 9000 hectares ranging in age up to 90 yrs. old. Various methods of establishment have been tried in the early stages of introduction but by 1918. Challenges to management are high rates of soil loss, uncontrolled fires, theft and management of a second rotation crop. The forestry division has conducted various research experiments in teak over the years in nursery, thinning and spacing, tree improvement, growth studies and methods to reduce erosion and increase understorey vegetation.

0046 Rao, P.S. 2003. **Status of teak in Andhra Pradesh**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

The total planted area up to 2000-2001 is reported as 1,11,931 ha. in the state. Recently the natural teak bearing forests which became degraded due to heavy biotic interference are rejuvenated with the involvement of local people constituted into Vana Samithies under the Community Forest Management. Management of degraded teak forests under the World Bank funded Andhra Pradesh forestry project and Andhra Pradesh community forest management project are undertaken by the state. Teak improvement programmes in the state which include selection trials of plus trees, progeny trials, germplasm banks, development and standardisation of pre-treatment of seed and vegetative propagation, bud grafting, production and storage methods of scion material, trials for rooting of leafy cuttings are under way.

0047 Samapudhi, K. 1957. **Some notes on teak in S.E. Asia**. FAO Teak Sub-Commission, Bandung FAO/TSC-57/19: 6p.

Discussed distribution of teak in Asia and the Far East, methods of teak exploitation, physical and mechanical properties of teak from various teak producing countries like weight, seasoning, shrinkage, calorific value, influence of rate of growth on the technical properties and marketing and grading of teak logs, squares and conversions.

0048 Samapudhi, K. 1967. **Country report on teak forestry, Thailand**. FAO Asia-Pacific and African Forestry Commissions, Rome FAO:T-67/8: 7p. FAO, Rome.

Covers the following topics: teak bearing area, management, artificial regeneration, protection, research on teak soils, site quality, increment and volume tables, studies on seed selection, pretreatment and sowing, thinning, fire protection, control of teak bee-hole borer, mechanical properties and genetic research.

0049 Seth, S.K; Yadav, J.S.P. 1957. **Country report from India on silviculture and management of teak**. FAO Teak Sub-Commission, Bandung FAO/TSC 57/7: 21p.

A review of structure, nutrients and water relations, geology, pH and soil deterioration and soil conservation in teak plantations of India, Burma, Indonesia and Pakistan.

0050 Siswamartana, S. 2003. **The ups and downs of teak forest management in Indonesia**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

In Indonesia, teak was introduced during the fourteenth century. The Dutch colonial rule extensively extracted the timber, leading to degradation of teak forests in the country. There are state teak forests and community teak forests in Java. The state teak forests, extending to about 600,000 ha are managed by the government enterprise called Perum Perhutani and the teak areas outside Java are looked after by the local government. Clonal seed orchards are established. Intensive silvicultural practices, including fertilization are adopted to increase the productivity. Community based forest management programmes are implemented.

0051 Zakaria, I; Lokmal, N. 1995. **Teak in Malaysia**. 2nd Regional Seminar on Teak, Yangon, Myanmar.

Go top

Environmental Factors

(See also 0272)

0052 Agni, T; Pandit, A; Pant, K; Tewari, A. 2000. **Analysis of tree vegetation in the Tarai-Bhabhar tract of Kumaun Central Himalaya**. Indian Journal of Forestry 23(3): 252-261.

The present study was undertaken to assess the regeneration pattern, tree diversity and qualitative characters of forests in the Tarai-Bhabhar belt of Kumaun Central Himalaya in Uttar Pradesh. The highest abundance was recorded for *Tectona grandis*.

0053 Akinsanmi, F.A. 1985. **Effects of rainfall and some edaphic factors on teak growth in south-western Nigeria**. Journal of Tropical Forest Resources 1(1): 44-52.

Major site factors affecting the growth of teak in several areas of South West Nigeria were studied. Multiple regression analysis of the growth data and soil analysis showed that teak volume growth was significantly correlated with rainfall, texture, organic matter content and soil pH. The site conditions necessary for good growth of teak are discussed.

0054 Banerjee, K.L.B; Lal, P. 1985. **Vegetation of the little known district Seoni - in Madhya Pradesh**. Indian Journal of Forestry 8(4): 292-297.

A description of dry scrub jungle and mixed dry deciduous forest, which is further subdivided using the abundance of teak and local variations in altitude and climate.

0055 Bhatia, K.K. 1955. **Factors in the distribution of teak in Madhya Pradesh**. Journal of Indian Botanical Society 34(4): 459-490.

Climate, surface geology and vegetation in a number of teak stands are described. The soils were studied for pH, moisture content, exchangeable Ca, Mg, K, total available phosphates, N, organic matter and C/N. A positive correlation was established between the growth and distribution of teak and soil pH, exchangeable Ca, Mg and phosphates.

0056 Bhatia, K.K. 1956. Contribution to the ecology of teak (*Tectona grandis* Linn.f.) in

Madhya Pradesh. Science and Culture 21(12): 721-726.

Presents some further data from a study made in 1952-54 and discusses the discontinuous distribution of teak in Madhya Pradesh, pH of the soils and the Ca requirements of teak and its significance.

0057 Bown, D.N; Bang, Y.H; Knudsen, A.B; Arata, A.A; Fabiyi, A. 1980. **Forest types and arbovirus vectors in the Mamu River Forest Reserve of southeastern Nigeria**. Mosquito News 20(1): 91-102.

In the forest reserves of south-eastern Nigeria, the indigenous forests is cleared and replaced by teak and Gmelina plantations. Aedes africanus was found abundantly at ground level throughout the reserve.

0058 Buvaneswaran, C; George, M; Mohan, S. 2003. **Distribution of rainfall under teak plantation**. Indian Forester 129(5): 571-577.

It is found that the seasonal variation of rainfall influence the stemflow and throughfall. It is also found that interception depends on parameters like crown form, density of the species, external structural features like bark characteristics and branching nature as well as rainfall pattern and other meteorological factors which influence the evaporation.

0059 Camacho, M. P. 1985. **Environmental factors and growth of 5 forest tree species in Costa Rica**. (Spanish). Technologia en Marcha 8(1): 27-33.

Multiple regression models were developed using the m.a.i. in volume as the dependent variable and 27 environmental factors. Models of best fit are presented for each species including teak.

0060 Chaves Salas, E; Chinchilla Mora, O. 1989. **Limiting factors in the growth of teak (*Tectona grandis* Linn.f.) in the area of Puntarenas, Costa Rica.** Guia Agropecuaria, Costa Rica 7(14): p64.

0061 Chunkao, K; Tangtham, N; Surachet Ungkulpadikul. 1971. **Measurements of rainfall in early wet season under hill- and dry-evergreen, natural teak, and dry-dipterocarp forests of Thailand**. Kog Ma Watershed Research Bulletin, Faculty of Forestry, Kasetsart University, Thailand 10: 31p.

Throughfall comprised about 37 percent, stemflow comprised 0.02 percent of the precipitation and interception was 63 percent for natural teak. The differences were related to the texture of the bark and leaves of the trees, interception being higher for species with rough bark and hairy leaves.

0062 Classen, J.C van R. 1910. **Need of light or tolerance of shade and related matters**. (Indonesian; English). Tectona 3: 375-381.

0063 Coster, C. 1921. **The physiological aspect of light in forestry**. (Indonesian; English). Tectona 14: 1033-1045.

0064 Dabral, B.G; Bali, H.K; Bhalla, H.K.L. 1964. **Dew studies under forest plantations at New Forest, Dehra Dun**. Indian Forester 90(3): 169-170.

Studies made over two cold seasons in fully closed stands of *Pinus roxburghii*, *Tectona grandis* and *Dendrocalamus strictus* showed that dew deposition was much retarded under cover, especially immediately below the crowns. No frost was recorded inside these plantations.

0065 Dabral, B.G; Prem Nath; Ramswarup. 1963. **Some preliminary investigations on the rainfall interception by leaf litter**. Indian Forester 89(2): 112-116.

A study was made of interception of rainfall by litter of *Shorea robusta*, *Tectona grandis*, *Pinus roxburghii* and *Dendrocalamus strictus*. Interception as percent of gross rainfall averaged for teak is 8.9. Interception increased as amount and intensity of rainfall decreased.

0066 Dabral, B.G; Prem Nath. 1972. **The microclimate of teak plantation**. Proceedings of Symposium on Man Made Forests in India, 8-10 June 1972. Society of Indian Foresters, Dehra Dun.

The paper presents the results of microclimatic studies made under a teak plantation and in the open at New Forest. The presence of forest vegetation, modified air temperatures both by its sheltering and blanketing effects, the effects being more pronounced during the winter season. Under the plantation, inversion took place in day time which generally occurred at night in the open.

0067 Eze, E.B. 1999. **Relationship between rainfall interception and rainsplash erosion under teak plantation in south western Nigeria**. Global Journal of Pure and Applied Sciences 5(4): 589-593.

Gross rainfall, throughfall and stemflow were measured on a storm basis. Interception loss and splash erosion by throughfall were calculated. The results show that teak plants intercepted 16 percent of the gross rainfall while throughfall accounted for 81 percent and the balance of 3 percent was stemflow. An equation relating throughfall and rainsplash erosion under teak was developed.

0068 Ferlin, G. 1969. **Forests and forestry problems in Ceylon**. (French). Bois et Forests des Tropiques 127/128: 3-28.

An account is given of the climatic zones and the present distribution of forests, geology and soils, large-scale afforestation programme in progress mainly with *Tectona grandis* in the dry zone, *Swietenia macrophylla* in the wet zone, and Eucalypts and Pines in the highlands and of the timber industry.

0069 Gogate, M.G; Kumar, A. 1993. **An ecological audit of teak plantations in West Chandrapur Project Division**. Indian Forester 119(4): 265-294.

Data on floristic composition and stand structure are presented and compared for four teak plantations, four areas of natural forest either adjacent to teak plantations, or with a higher percentage of teak. It is found that clear felling followed by teak planting will not affect plant diversity. This finding is attributed to safety measures adopted at clear felling which involved retention of small patches of original forest in the form of section and compartment lines, roadsides, retention of fruit trees etc.

0070 Griffith, A.L. 1945. **Snowfall in Dehra Dun**. Indian Forester 71: 117-118.

Many of the exotic tree species under cultivation at Dehra Dun suffered severely of the snowfall and frost of 1945. Main stems were broken in a very large percentage of teak. The relative amount of damage suffered by the various species is shown in tabular form.

0071 Gupta, A.C; Gurumurti, K; Raturi, D.P. 1983. **Ratanmal Forest and some of its plant constituents**. Van Vigyan 21(1/2): 26-29.

The Ratanmal Forest is a 5565-ha reserved forest in the Panchmahals District of Gujarat. It has good quality moist teak and southern moist mixed deciduous forest types.

0072 Hadipoernomo. 1979. **Magersaren in teak forest**. (English; Indonesian). Duta Rimba 5(29): 10-15.

0073 Kulkarni, D.H. 1956. **Distribution of teak (*Tectona grandis*) on the northern slopes of the Satpuras, with special relation to geology**. Proceedings of the 8th silviculture Conference, Dehra Dun, 1951, Part 2: 254-266.

Extensive observations failed to establish any significant correlation between the distribution of teak and altitude, topography, rainfall, temperature or biotic factors. A correlation was found with geographical formation, the proportion of teak varying from 80 percent on rocks of the Deccan Trap Series to none on sandstones.

0074 Luangjame, J; Boontawee, B; Kliangpibool, N. 2001. **Determination of deposition and leaves in teak plantations in Thailand**. Water, Air and Soil Pollution 130(1-4): 935-940.

0075 Mwalyosi, R; Hughes, R. 1998. **The performance of EIA in Tanzania: An assessment**. Environmental Planning Group, International Institute for Environment and Development, Environmental Planning Issues 14: 95p. London, UK.

An examination is made to determine the influence of environmental impact assessment on decision-making at the national level within Tanzania. Seven case studies are presented which include teak plantation establishment.

0076 Nguyen Khac Hieu; Booth, T.H. 2003. **Application of the COMAP model for developing and evaluating forestry greenhouse gas mitigation options in Vietnam**. Carbon accounting in forests. Proceedings of an International Frontiers of Science and Technology Workshop, CSIRO Forestry and Forest Products, Canberra, Australia, 24 February, 2003: 56-64. Australian Academy of Technological Sciences and Engineering, Parkville, Australia.

Some of the main features of Vietnam's forests including the areas and annual growth rates of major forest types are described. The COMAP model is used to assess greenhouse gas mitigation options including three forestry options which include long-term rotation reforestation using species such as teak. It is concluded that the forestry sector has great potential to mitigate greenhouse gas emissions. There is a need to initiate significant pilot scale forestry mitigation options to demonstrate their feasibility, as well as to develop appropriate methods for assessing greenhouse gas flows and their verifiability.

0077 Plodpleaw, A. 1965. **Comparison of temperature in natural forest, teak plantation and open areas**. (Thai). Student Thesis. Kasetsart University, Bangkok.

No differences in temperature were found.

0078 Prasad, R. 1980. **Ecological status of *Diospyros melanoxylon* in dry deciduous teak forests of Sagar (Madhya Pradesh)**. Indian Forester 106(1): 41-52.

The forests of Sagar are very heterogenous in their composition, quality, density and extent. The microclimate differences produced due to variation in slope, aspect, relief, proximity to water courses, soil and geological formation cause a very perceptible variation in the vegetation. Besides the climatic factors, the edaphic and biotic factors also affect the distribution composition and quality of the crop. Diospyros melanozylon is found as main associate of forest stands.

0079 Qureshi, I.M. 1963. **The concept of tolerance in forest crops**. Silver Jubilee Souvenir 1938-1963. Indian Forest College, Dehra Dun: 90-100.

Attempts to determine whether the indices of tolerance prepared by Gevorkiantz on the basis of the relationship of mean height and mean diameter are applicable to those Indian species for which yield tables are available including teak.

0080 Salazar, F.R; Albertin, W. 1974. **Edaphic and climatic requirements for *Tectona grandis* Linn.f.** (Spanish). Turrialba 24(1): 66-71.

It is shown that *Tectona grandis* requires deep, well drained soil at a low elevation, and a frost-free climate with 3-5 months of drought.

0081 Siringoringo, H.H; Gintings, A.N. 1997. **The role of *Tectona grandis* forest plantations in absorbing carbon dioxide**. Buletin Penelitian Hutan 608: 1-18.

The role of teak in the CO_2 sequestration was investigated in plantations in Bojonegoro Forest District, East Java, where an analysis was undertaken of microclimatic conditions of light intensity, relative humidity, air pressure and temperature and ppm CO_2 in seven stand age classes. Absorption of CO_2 by the plantations varied by age class, with absorption ability highest in old age classes.

0082 Tiwari, S.D.N. 1954. **Teak the intruder *vis-a-vis* occurrence of teak in sal forests of Bastar**. Indian Forester 80(6): 332-337.

It is considered that teak was introduced from the south at an early date. It appears to be gradually supplanting sal in the forests of this area.

0083 Verma, R.K; Gupta, S.R; Anand, K. 2000. **Floristic composition and life form of a mixed dry deciduous forest of Central India**. Flora and Fauna Jhansi 6(2): 79-81.

A study was conducted to determine the botanical composition and life form of a natural mixed dry deciduous forest in the Bundelkhand region in Uttar Pradesh. Results showed that 23 species comprise the study area out of which the two most common and dominating species were *Anogeissus pendula* and *Tectona grandis*.

Go top

Site Factors

(See also 0172, 0342)

0084 Akindele, S.O. 1991. **Development of a site index equation for teak plantations in southwestern Nigeria**. Journal of Tropical Forest Science 4(2): 162-169.

A site index equation is developed for estimating the site quality of existing teak plantations in SW Nigeria. The procedure for using the equation is illustrated.

0085 Boonkird, S; Dawson, M.D; Stone, E.L. 1960. **A preliminary study of teak soils and sites in Lampang province, Thailand, June 1960**. Journal of the National Research Council of Thailand 1(1): 27-75.

A study is made of natural teak forests in northern Thailand mainly soils and vegetation and measurements of mature teak trees. Height of mature teak, which was found to be related closely to volume, fairly closely to girth, but not to current diameter growth and was considered a good index of site quality. A positive correlation with organic-matter content, internal drainage, rooting depth, and most markedly with soil moisture storage capacity but none with pH, P content, or ground vegetation.

0086 Chand Basha, S; Sankar, S. 1997. **Future of teak in Kerala**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 208-211. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Kerala State has a long history of teak cultivation and plantations of the third rotation can be located at Nilambur Forest Division. This paper attempts to review the status of teak plantations in Kerala *vis-a-vis* site quality, soil conditions, rotation age, etc. A critical analysis of teak culture with specific case studies on growth of teak and soil and site conditions is presented. While discussing certain options for further course of action, an attempt is made to predict the future of teak in Kerala.

0087 Chauhan, V.S. 1973. **Relationship of some components of physical environment to the site quality of teak in Madhya Pradesh**. Silvicultural Conference, 6-10 December, 1977. Forest Research Institute, Dehra Dun.

An evaluation of site quality of teak in relation to elements of climate and soil is made. A general equation has been evolved for forecasting the site quality through the basic data of physical environment, comprising of soil and climate of eleven forest divisions, ranging from dry to moist teak zones.

0088 Drechsel, P; Zech, W. 1994. **DRIS evaluation of teak (*Tectona grandis* Linn.f.) mineral nutrition and effects of nutrition and site quality on teak growth in West Africa.** Forest Ecology and Management 70(1/3): 121-133.

An investigation was made to study site variables controlling teak yield and to establish guidelines for the selection of high productivity sites in Benin, Cote d'Ivoire, Liberia, Nigeria and Togo. Depending on stand age, soil and region, between 70 and 90 percent of the variation in tree growth could be explained by the supply of nitrogen, root available, soil depth and precipitation.

0089 Forest Department, Andhra Pradesh. 1966. **Note on selection of area for planting with teak**. Forest Department, Andhra Pradesh, C.C.F's 73473/65/H4 Dt. 29-6-1966.

A departmental note in the form of instructions for selection of area for teak planting and proper survey of forest soils, to determine their suitability.

0090 Haeruman, H. 1970. **Linear combination of stand variables as a means for site classification of teak (*Tectona grandis* Linn.f.) plantations in Java.** De University, USA: 66p.

0091 Haeruman, H. 1971. **Problems in assessment of site quality**. Rimba Indonesia 16(1/2): 1-10.

A review, concluding that in managed plantations there are advantages in the simultaneous use of height, d.b.h. and age to assess site quality.

0092 Herrera, B; Alvarado, A. 1998. **Site quality and environmental factors in Central American forests**. Agronomia Costarricense 22(1): 99-117.

Published information related to the estimation of the productive capacity of sites were compiled based on environmental factors in forests of known age in Central America. The methods used to estimate age, the size and the number of sample plots, the site quality indicators, the criteria used in the selection of each study site and the soil sample depth were compared. The climatic, topographic and soil factors that affect the productive capacity of the species considered were also analysed.

0093 Kadambi, K. 1945. **Teak plantations in Mysore and their site quality**. Indian Forester 71: 58-62.

Most of the early plantations of teak in Mysore were formed on sites adjoining rivers, owing to the once prevalent idea that the proximity of running water was necessary for the successful regeneration of this species. Data are given showing the rate of growth of teak in Mysore as compared with that of other sites in different parts of India.

0094 Keogh, R.M. 1982. **Teak (*Tectona grandis* Linn.f.) provisional site classification chart for the Caribbean, Central America, Venezuela and Colombia.** Forest Ecology and Management 4(2): 143-153.

Based on top height, dominant height and dominant/codominant height data from thirteen countries is given.

0095 Kolmert, A. 2001. **Teak in Northern Laos**. Minor Field Studies, International Office, Swedish University of Agricultural Sciences 175: 40p. Swedish University of Agricultural Sciences, International Office, Uppsala, Sweden.

A study was made to evaluate land use for teak plantations and its implications. Teak plantations on flat, gentle and steep slopes were studied in order to describe teak growth rates, erosion, undergrowth, soil properties for the different slope categories, ownership structure and management. It is suggested that intercropping will be an effective measure to mitigate erosion.

0096 Kulkarni, D.H. 1956. **Geography of sal and teak with special reference to Madhya Pradesh**. Proceedings of the 9th Silvicultural Conference, Dehra Dun, 1956, Part 2: 108-112.

The natural distribution of these two species and specially their economic relationship in Madhya Pradesh are discussed in the light of their characteristics and evolutionary history.

0097 Lauridsen, E.B; Apichart Kaosa ard. 1973. **Site effects unstored more than stored stumps of teak**. TIC Experiment 77: 13p. Teak Improvement Centre, Ngao.

Gives the results of experiments done on treatments - control and underground storage, with different storage media-sawdust; rice shells and plastic foil and with different lifting dates for plants to stored and unstored plants. Storing medium has no effect on survival and development. Ground storage is associated with higher levels of survival.

0098 Lu-Junpei. 1994. **Site classification and evaluation of teak forests in Hainan, China**. (Chinese). Forest Research 7(6): 677-684.

The site classification and evaluation of teak forests in Hainan Island were studied. The site index is used as a criterion variable and the six ecological factors are used as explanatory variable in which the soil fertility is one of the ecological factors.

0099 Maimongkol, W. 1965. **Determination of the value of constants of teak from form factors and form quotients in Huay-Tark Forest, Ngao, Lampang**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Use of Girard form class and 1/10 form class to find out taper form of site class 1-4 is discussed. Use of Kunze form factor for different site classes and its relative significance is also discussed.

0100 Marcelino Montero, M; Ugalde Arias, L.A; Kanninen, M. 2001. **The relationship between site index and site factors known to influence the growth of *Tectona grandis* Linn.f. and *Bombacopsis quinata* (Jacq.) Dugand, in Costa Rica**. (Spanish). Revista Forestal Centroamericana 35: 13-18.

Site indices for *Tectona grandis* and *Bombacopsis quinata* were correlated to site and soil variables obtained from different regions in Costa Rica. Mean annual precipitation presented a positive correlation with site index for *T. grandis*. Site index for *T. grandis* also presented a positive correlation with topographic position, indicating that the species grows well in flat lands and on medium slopes.

0101 Morellet, J. 1968. **Forestry problems in Cuba**. (French). Bois et Forests des Tropiques 122: 3-24; 123/124: 3-17.

An account is given of climate, topography, geology and soils, forest history, forest types, afforestation by planting softwood and hardwoods planted include *Tectona grandis*, silvicultural research, forest production and problems of land use and forest policy.

0102 Neumann, A; Neumann, A.J. 1988. **Provisional site index curves for five Solomon Islands plantation species**. Forestry Division, Solomon Islands, Forest Research Note 42-10-88: 9p.

Site index equations and curves are presented for different species which include *Tectona grandis*, based on data from permanent sample plots, permanent growth plots and experimental trials at three sites. Descriptions of soil types, land form and fertility are given for each site.

0103 Raghavan, M.S. 1948. **Further note on constants connecting top height and age for different site qualities in teak plantations**. Indian Forester 74(5): 209-210.

The paper puts forth a formula method of determining the equality of a teak plantation of known age and top height points out the need of exploratory work on actual observed data before establishing the relationship.

0104 Rao, B.K.S; Pande, S.K. 1982. **Effect of forest tree and litter covers on climate near the ground including surface soil temperature and soil moisture in three forest plantations of chir (*Pinus roxburghii*), sal (*Shorea robusta*) and teak (*Tectona grandis*) at New Forest, Dehra Dun**. Indian Forest Records, Forest Influences 1(1): 74p.

0105 Sahunalu, P; Phromsilp, V; Suraphapmaitri, S. 1992. **Site index and yield of teak plantation in Lampang**. Proceedings of the Seminar on 50 Anniversary of Hyay-Tak Teak plantation, Bangkok, 5-8 August 1992.

Study of site index and yield of teak plantation was carried out in nine plantations of Lampang province. Diameter at breast height and total height of teak in plots were measured. The relationship between age and average height of the dominant and co-dominant trees in each plot was found out and a curve was drawn to form the site index.

0106 Salifu, K.F. 2001. **Site variables controlling teak (*Tectona grandis*) growth in the High Forest Zone of Ghana**. Journal of Tropical Forest Science 13(1): 99-108.

Site variables controlling teak growth are investigated to recommend guidelines for the selection of suitable and highly productive sites for industrial scale teak plantation establishment. Regression techniques were used to relate teak dominant height growth with soil textural properties under teak plantations in the High Forest Zone of Ghana.

0107 Tanaka, N; Hamazaki, T; Vacharangkura, T. 1998. **Distribution, growth and site requirements of teak**. JARQ, Japan Agricultural Research Quarterly 32(1): 65-77.

The successful teak plantations are found in discontinuous areas with fertile soils, which are intrazonal and azonal soils derived from limestones, base-rich igneous rocks and alluvial materials. The discontinuous distribution of natural forests and plantations of teak is attributed to the discontinuous occurrence of suitable intrazonal and azonal soils. The optimum soil conditions for teak growth include good drainage, deep subsoil, slightly acid to alkaline pH, and abundance of bases.

0108 Thammanon, P. 1970. **Site quality of mixed deciduous forest with teak at Mae-Huad as determined by soil aggregate**. Proceedings of the 3rd National Forestry Conference of Royal Forest Department, Bangkok: 1-12p.

Soil samples from A and B horizon were collected and total height and d.b.h. of all trees in plots are measured.

0109 Tinambunan, D. 1991. **Reduction of productive forest area and environmental disturbance due to hauling infrastructure construction in teak forest area**. (Indonesian). Duta Rimba 17(131/132): 33-38.

A report on the state of forest roads and railroads in teak forest in Cepu and Randablatung Forest Districts, Java. The erosion potential of the roads is considered to be low.

0110 Woraraksa, B. 1964. **Site quality of Lampang teak plantations**. (Thai). Student Thesis. Kasetsart University, Bangkok.

0111 Yang, Y.C; Wang, D.C (*et al*). 1970. **Site class studies on important tree plantations in Taiwan**. (Chinese; English). Taiwan University, Forestry Experiment, Technical Bulletin 80: 52p.

Describes studies of the relation between site factors and growth of teak and other species on plots in the main districts of Taiwan, including the development of site index curves adjusted for stand density by means of the crown competition factor and studies of the relation of site index to seven site factors, with tables for estimating the site index of unforested land on the basis of altitude, slope, and texture and depth of soil.

Go top

Undergrowth

(See also 3136, 3154, 3160)

0112 Anvery, S.A.A. 1940. **Grass and teak plantations**. Indian Forester 66: 285-286.

It is suggested that unchecked grass growth in teak plantations and the consequent soil impoverishment of nitrogenous matter, may be partly responsible for premature flowering and fruiting of teak and for the related phenomenon of lessening or stoppage of vegetative growth.

0113 Berger, L.G den. 1926. **Timber species from the growing areas of Java and Sumatra's east coast**. (Indonesian; English). Meded Proefsta Boschw 13: 186p. G. KOLEF and Company, Batavia.

0114 Beumee, J.G.B. 1919. **Small flora in teak forests**. (Indonesian; English). Tectona 12: 146-203.

0115 Beumee, J.G.B. 1922. **Analytical investigations of small flora in artificial teak plantations in Java in connection with development of teak stand**. (Indonesian; English). Dissertation, Agricultural University, Wageningen.

0116 Bhatia, K.K. 1959. **Teak bearing forests of old Madhya Pradesh**. Indian Forester 85(12): 710-722.

Detailed descriptions of the forests and their floristic composition.

0117 Champion, H.G. 1933. **Underplanting in teak plantations**. Indian Forester 59(5): 277-282.

The performance of underplanted crop of *Leucaena* is stressed. Trials of mixtures with *Dalbergia latifolia* is recommended, while listing *Swietenia macrophylla* and *Derris microphylla* as two of the successful species from twenty three species tried.

0118 Chandrasekharan, S; Sundarapandian, S; Chandrasekar, P; Swamy, P.S. 2001. **Exotic plant invasions in disturbed and man-modified forest ecosystems in the Western Ghats of Tamil Nadu**. Tropical forestry research: Challenges in the new millennium. Proceedings of the International Symposium, Peechi, India, 2-4 August, 2000, R.V. Varma; K.V. Bhat; E.M. Muralidharan; J.K. Sharma, Eds: 32-39. Kerala Forest Research Institute, Peechi.

The consequences of biotic activities with reference to exotic plant invasions were studied in natural forest and savannah and man-modified ecosystems including teak plantation and wastelands of the Western Ghats of Tamil Nadu.

0119 Chaubey, O.P; Mishra, G.P; Ram Prasad. 1988. **Phytosociological studies of teak plantations and mixed natural forests in Madhya Pradesh. II. Distribution, species diversity, productivity and some quantitative parameters of ground flora**. Journal of Tropical Forestry 4(2): 177-187.

The ground flora was studied using quadrates in an age range of teak plantations in 2 edapho-climatic regions of Madhya Pradesh and in their adjoining natural forests. Data are tabulated for each study site showing the importance value indices of the species found, numbers of species, total density, community coefficients between each plantation and its adjoining natural forest and above-ground biomass.

0120 Chaubey, O.P; Prasad, R; Mishra, G.P. 1988. **Studies of teak plantation and mixed natural forests in Madhya Pradesh**. Journal of Tropical Forestry 4(1): 22-35.

Comparative studies were made of floristic composition, species diversity and quantitative ecological parameters of frequency, density, basal area and importance value index. No discernable differences were found in the floristic composition of tree species under teak plantations and their adjoining natural forests. Total density and total basal area were also higher in teak plantations than in adjoining natural forests.

0121 Coster, C. 1933. **Root competition in the tropics, particularly regarding teak (*Tectona grandis* Linn.f.).** Indian Forester 59(10): 672-677.

0122 Coster, C. 1933. **Root studies in the tropics IV. Root competition**. (Dutch; German; English). Tectona 26(6).

It is found that the root competition of the old trees is the principal agent in retarding the growth of the teak plantation bordering an old forest. Teak is found very susceptible to root competition.

0123 Daryono, H. 1985. **Effects of age on the composition and development of teak (*Tectona grandis*) undergrowth flora**. Buletin Penelitian Hutan, Pusat Penelitian dan Pengembangan Hutan 469: 67-93.

Data are presented and analysed from 10-50 yr old plantations in Randublatung Forest District, Central Java.

0124 Das, A.P; Lahiri, A.K. 1990. **Angiospermic flora of Bethuadahari Reserve forest, Nadia (India)**. Indian Forester 116(11): 871-882.

The Bethuadahari Reserve in West Bengal is a deer sanctuary which has the appearance of a natural forest. The entire area was planted with different tree species including *Tectona grandis*. A pair of spotted deer, five sambars, thirteen spotted deer and three barking deer were released to the sanctuary. This study of the flora of the sanctuary was undertaken to ascertain the floristic composition in relation to controlled and open grazing and to determine the species grazed.

0125 Dawkins, H.C. 1956. ***Tectona grandis* as suppressor of *Imperata***. Forest Department, Uganda, Technical Note 16/56: p1.

All three plots of teak plantations were infested in the first four years after establishment, but were almost free after 7-8 years. Eight months after 30 percent thinnings, grass was increasing and though unlikely to regain its former vigour was sufficient to renew the fire hazard.

126 Eidmann, F.E. 1932. **Teak forests and undergrowth in Java**. Tectona 25(12): 1628-1675.

127

0127 Ganglo, J.C. 2001. **Study of the latitudinal gradients of the natural undergrowth of**

teak (*Tectona grandis*) plantations in south and central Benin. (French). Plant systematics and phytogeography for the understanding of African biodiversity. Proceedings of the XVIth AETFAT Congress, National Botanic Garden, Belgium, 28 August-2 September 2000. Systematics and Geography of Plants 71(2): 807-816.

A phytosociological assessment has been done in the natural undergrowth of teak plantations using the Braun-Blanquet approach in south and central Benin. The results help to identify three phytogeographical groups from south to north. The variance analysis of the phytogeographical types highlights significant gradients at 5 percent level of probability.

0128 Ganglo, J.C; Lejoly, J. 1999. **Biotope and ecological indicator value of the *Lecaniodiscus cupanioides* and *Landolphia calabarica* association in the natural understorey of the teak plantations of south Benin**. (French). Acta Botanica Gallica 146(3): 227-245.

The site characteristics and ecological indicator value of the plant community Landolphio-Lecaniodiscetum cupanioidis were studied in the natural understorey of the teak plantations of Djigbe forest in south Benin. The association is linked to the sites presenting the largest risks of wind throw, by reason of the shallow depth of the large roots.

0129 George, M; Varghese, G. 1989. **Phytosociology of Mudumalai forest vegetation continuum**. Journal of Tropical Forestry 5(1): 70-75.

The Mudumalai forest division is one of the most important reserved forests of Tamil Nadu because of its rich flora and wildlife. A preliminary survey of the forest had revealed the presence of various vegetation communities without boundaries, and this paper presents an analysis based on the continuum concept, with the variation in continuum index being correlated with a moisture gradient. Four main communities were identified which include *Tectona grandis*.

0130 Hadipoernomo. 1978. **The forest as source of traditional medicines**. (English; Indonesian). Duta Rimba 4(26): 56-60.

Modern processing and marketing have increased the popularity of traditional Javanese medicines both in Indonesia and abroad. The state forest enterprise Perhutani in 1976 began trials of growing medicinal herbs in Java as a ground layer in mature teak plantations, the method of cultivation and medicinal uses are briefly described for certain plants.

0131 Jafarsidik, Y; Sutomo, S. 1991. **Medicinal plants among the undergrowth of the teak forest and their use in traditional therapeutic practices in Bitakol, the buffer zone of the Baluran National Park, East Java**. (Indonesian). Buletin Penelitian Hutan 533: 37-46.

Medicinal plants constituted about 66 percent of the undergrowth in the teak forest at Bitakol in 1989. Tables are given listing the species found, with data on their density, frequency of occurrence, etc. Notes are given on some of the plants, its local names, description and utilization.

0132 Kant, S. 1997. **Integration of biodiversity conservation in tropical forest and economic development of local communities**. Journal of Sustainable Forestry 4(1/2): 33-61.

A methodology for quantification of the contribution of all non-timber forest products is suggested and applied to a sample of seven villages in India. A comparative analysis of the contributions of NTFPs in two major types of forest cover, teak and sal is made.

0133 Kapoor, S.L; Kapoor, L.D. 1973. **Further contribution to the flora of the Karimnagar District of Andhra Pradesh**. Bulletin of the Botanical Survey of India 15(1/2): 76-84.

The composition of the teak forests and the characteristic of the region is described, and a systematic list is given of sixty six species not previously recorded in the area.

0134 Korihalli, S.H. 1956. **A note on the optimum proportion of miscellaneous species in mixed teak (*Tectona grandis*) forests**. Proceedings of the 9th Silvicultural Conference, Dehra Dun 1956, Part I: 70-73.

Deals with deciduous forests of the western part of Mysore state where teak is an important species. Records composition of different teak forests and observes lack of natural regeneration and factors responsible for this situation. Methods to control and foster teak regeneration in these forests are given.

0135 Krishnaswamy, V.S. 1953. **Cover and nurse crops in sal and teak plantations at Dehra Dun**. Indian Forest Bulletin 185 (n.s.) Silviculture.

Describes Dehra Dun experiments on the growing of cover and nurse crops in sal and teak plantations, mainly with the object of improving impoverished soils of New Forest estate.

0136 Krishnaswamy, V.S; Puri, G.S. 1954. **Results of an experiment to study the succession of ground flora species under forest plantations raised on old agricultural land in the New Forest, Dehra Dun, India**. Indian Forester 80(9/10): 522-530.

Frequencies of ground vegetation were recorded in plantations including *Tectona grandis*. The data are examined and faults in the lay out of the plots are discussed.

0137 Luoma, J. 2002. **Understorey vegetation characteristics along teak (*Tectona grandis*) plantation/natural forest ecotones in Costa Rica**. Tropical Resources: Bulletin of the Yale Tropical Resources Institute 21: 11-16. Yale School of Forestry and Environmental Studies, New Haven, USA.

A study was conducted in the Parrita Valley in Costa Rica to examine the relationship between teak litter and understorey variables. Results showed that teak litter weights were very weakly correlated with understorey cover or species. Slope percentages had a positive correlation with teak litter weight.

0138 Mishra, T.K; Namta, B; Dehari, B; Banerjee, S.K. 1993. **Species diversity under sal and teak plantations in lateritic region**. Indian Journal of Tropical Biodiversity 1: 188-201.

0139 Nobles, R.W; Briscoe, C.B. 1966. **Mowing understorey vegetation in a young teak plantation**. (English; Spanish). United States Forest Service Research Notes, Institute of Tropical Forestry, Rio-Piedras ITF 9: 2p.

Mowing 1-4 times annually in 1963-66 to control *Panicum maximum*, *Leucaena glauca* and *Acacia macrantha* reduced fire danger but had not significant effect on d.b.h. or height increment of teak planted in 1956.

0140 Puri, G.S; Dabral, S.N. 1957. **Succession on ground flora species in the forest plantations of New-Forest, Dehra Dun**. Indian Forester 83(9): 551-554.

Deals with succession of ground flora in plantation including teak in New Forest, Dehra Dun.

0141 Rochmini S dan. 1983. **The teak cycle**. Duta Rimba 9(65/66): 21-25.

The definition of an optimum cycle in Indonesian teak forests is discussed in relation to their multiple benefits/products which include taungya crops, the production of wood other than teak, medicinal herbs etc.

0142 Ross, P. 1961. **The plant ecology of the teak plantations in Trinidad**. Ecology 42(2): 387-398.

An analysis of the vegetation invading teak plantations, based on transects through plantations established by taungya in 1938, 1943, 1948 and 1954 in broadleaved evergreen forest types.

0143 Saha, S. 2001. **Vegetation composition and structure of *Tectona grandis* plantations and dry deciduous forests in central India**. Forest Ecology and Management 148(1/3): 159-167.

Vegetation structure and composition of abandoned teak plantations was compared with the neighboring dry deciduous secondary forests in Madhya Pradesh. Species diversity and stem density were compared between plantations and secondary dry deciduous forests separately for adults and seedlings of trees, shrubs and lianas.

0144 Srivastava, V.K. 1986 . **Diversity and dominance in two man-made forests at Dehra Dun, India**. Indian Journal of Forestry 9(4): 287-292.

Number of species, the Shannon-Wiener index, Simpson's index, total basal area and total density and the importance value index were determined from the quadrate data. The diversity and dominance indices were inversely correlated in a curvilinear fashion in both plantations. Values are tabulated for basal area, importance value index and dominance index of each species in the two plantations.

0145 Thapliyal, M; Selvi, K.G; Lakshminarayan, U; Mohan, E. 2002. **A comparative study of ground flora of unilocational monoculture of *Acacia auriculiformis*, *Casuarina equisetifolia*, *Eucalyptus tereticornis* and *Tectona grandis* in Panampally, Palakkad District, Kerala.** Indian Journal of Forestry 25(1/2): 82-86.

This study was conducted on the ground flora of plantations including *Tectona grandis* in Panampally, Palakkad District of Kerala. A total of 59 species were recorded from the area.

0146 Thorenaar, A. 1929. **Uninterrupted covering of the forest floor**. Tectona 22: 318-320.

0147 Totey, N.G; Prasad, A; Kapoor, K.S; Nautiyal, S; Khatri, P.K; Bhowmik, A.K. 1989. **Studies on the growth performance of some green manure leguminous crops and their residual effect on the organic matter and available nutrients in eroded teak nursery soils of Nainpur**. Indian Forester 115(6): 404-413.

Growth measurements of the green manure crops were made after 30 and 60 days, and plant samples analysed for N, P and K. After 8 weeks the crops were ploughed in and allowed to decompose for 90 days. Soil samples were analysed before and after treatment for organic matter, and for available N, P and K, at 0-15 and 15-30 cm depths.

0148 Verma, R.K; Shadangi, D.K; Swain, D; Totey, N.G. 1996. **Status of plant diversity in Rajin preservation plot, Orissa**. Environment and Ecology 14(1): 227-234.

Data are tabulated on the synecological characteristics and regeneration of the preservation plot and a plot outside it, where forestry operations had continued. The index of diversity and index of dominance were higher in the preserved plot than in the unpreserved plot.

0149 Vora, A.B; George, V.C. 1987. **The distribution of various life forms in the ground flora under different canopies of Panchamahals forests, Gujarat, India**. Indian Journal of Forestry 10(3): 223-225.

Studies were made of the seasonal distribution of ground flora at five sites in different stages of canopy degradation, including three highly degraded forests, one conserved forest and one semi-degraded forest. Possible explanations and seasonal variations are discussed.

Go top

Animal and Birds

(See also 2121)

0150 Bell, H.L. 1979. **The effects on rain-forest birds of plantings of teak, *Tectona grandis*, in Papua New Guinea**. Australian Wildlife Research 6(3): 305-318.

Plantations of the introduced teak in New Guinea had little lateral branching, few epiphytes or climbers and little undergrowth. There were far fewer species of bird and mammal than in rain forest. A main food resource in teak was the teak moth, birds ate the larvae or pupae.

0151 Djuwantoka. 1991. **Habitat use of silver leaf monkey (*Semnopithecus auratus* E. Jeoffrey, 1812) in teak (*Tectona grandis* Linn.f.) plantation of Cepu, Central Java, Indonesia**. Philippines University College, Laguna, March 1991: 177 leaves.

A survey showed that six types of habitats in teak forest plantation were used by the Silver Leaf Monkey. Each habitat type had its own characteristics, structure and composition of vegetation which was distinguished from the other in terms of use by the Silver Leaf Monkey. This troop fed mainly on leaves, with the leaf petioles of teak leaves as the most preferred. Teak forest is deemed compatible with wildlife, particularly that of the silver leaf monkey.

0152 Gopal, R. 1988. **Effect of silvicultural practices on the status of wildlife: A case study in the Pench Sanctuary of Madhya Pradesh**. Journal of Tropical Forestry 4(1): 11-21.

The area studied was in the South Seoni Forest Division which contains three forest types which include moist teak forest and Southern Tropical Dry Deciduous teak bearing forest managed by 3 overlapping working circles for teak conversion, selection-cum-improvement and bamboo. Habitat relations were studied in selected thinning and main felling coupes.

0153 Hinde, R.J; Corti, G.R; Fanning, E; Jenkins, R.K.B. 2001. **Large mammals in miombo woodland, evergreen forest and a young teak (*Tectona grandis*) plantation in the Kilombero Valley, Tanzania**. African Journal of Ecology 39(3): 318-321.

This paper describes the frequency of large mammal use of evergreen forest, miombo woodland and teak plantation in the Kilombero Valley, Tanzania. Signs of small gleaners like duiker and bushbuck were most common in the teak plantation. The bulk feeders like elephant and buffalo avoid the teak plantation.

0154 Hsu, M.J; Agoramoorthy, G. 1996. **Conservation status of primates in Trinidad, West Indies**. Oryx 30(4): 285-291.

0155 Kotwal, P.C. 1987. **Vegetational studies in Noradehi Sanctuary, Madhya Pradesh with reference to wildlife management**. Journal of Tropical Forestry 3(3): 254-367.

Noradehi Wildlife Sanctuary was established in 1975 in dry deciduous teak forest. The most frequently occurring tree species were teak and *Terminalia tomentosa*. It is suggested that the sanctuary in future be maintained as a national park so that it can develop into a wilderness area.

0156 Lees, J.C; Kader, R.A; FAO. 1979. **The world's forests**. Forest and Timber 15(1): 21p.

A special issue of seven articles include an article entitled teak forests still the elephant's domain.

0157 Nair, P.V; Jayson, E.A. 1988. **Habitat utilization by large mammals in teak plantations and natural forests**. KFRI Research Report 56 (Summary): 11p. Kerala Forest Research Institute, Peechi.

An analysis was made of transects laid out in 1-, 3-, 16- and 62-year-old teak plantations and adjoining moist deciduous natural forest in the Parambikulam Wildlife Sanctuary in Kerala. The data were used to estimate resource availability, animal abundance, the extent of animal visits and type and amount of animal damage. It is suggested that damage by elephants could be reduced by mixing stretches of natural forests with different aged plantations.

0158 Perla, J; Finegan, B; Delgado, D. 2002. **Potential of teak and paja blanca for avifauna diversity conservation in Gatun lake subwatershed, Panama Canal**. (Spanish). Revista Forestal Centroamericana 38: 27-32.

A study is made to assess the role of teak plantations on bird diversity conservation in the tropical forest of the Gatun lake's sub-watershed, in the Panama Canal area. Bird population richness, abundance and diversity were evaluated in two teak plantations.

0159 Saxena, V.S. 1973. **Birding in Pratapgarh teak forests**. Indian Forester 100(7): 466-474.

The teak forests of Pratapgarh range, Chittorgarh Forest Division, Rajasthan, are described and 52 species of birds belonging to 42 genera and 25 families were observed.

0160 Sody, H.J.V. 1953. **Birds of the Javanese teak forest and a consideration of their value and damage in it**. (Dutch). Madj. Ilmu Al. unt. Indonesia 109(4/6): 125-720.

Lists 167 species reported in teak forests since 1853, with some indication of their food and to what extent they are dependent on the forest or are merely chance visitors, and discusses their value in insect control.

Go top

Soil Properties

(See also 0085, 0088, 0147, 0703, 2442, 2870, 3528)

0161 **Forest soils**. Indian Forester 68(10), 1942: 548-549.

Investigations showed that clay recovery from lateritic soils increased with fineness of grinding, the percentage increase from coarsest to finest grade, calculated on the basis of the non-clay fraction, giving some indication of the deterioration of the soil under teak. The formation and accumulation of clay, the removal of free silica and the accumulation of combined silica seem to render soil unsuitable for the growth of teak.

0162 **Forest soils**. Indian Forester 68, 1942: 329-332.

From soil analyses at Nilambur it is suggested that determination of the molecular ratios-SiO_2: R_2O_3, SiO_2: Al_2O_3 and SiO_2: Fe_2O_3-in the total soil may furnish a better index of lateritic condition and the suitability or non-suitability of the soil for teak.

0163 **Laterization of soil in teak plantations**. Forest Research India and Burma, Part 1, 1946: 86-89.

In deteriorating soils of teak plantations there is a tendency for sesquioxides to accumulate and silica to leach out. This feature and several topographical and morphological characteristics of the soil profile appear to influence the growth of teak.

0164 **Laterization of soil in teak plantations**. Forest Research India and Burma 1945-46, 1947: 92-100.

An attempt was made at forecasting the quality of teak soil to be expected after clear felling a natural forest and planting of teak.

0165 **Bibliography on soil requirements of forest trees 1940-1958**. Bibliographic Bureau of Soils, Harpenden 186, 1959: 34p.

Comprises 178 references with brief abstracts arranged by species, including teak and other tropical and sub-tropical species.

0166 Aborisade, K.D; Aweto, A.O. 1990. **Effects of exotic tree plantations of teak (*Tectona grandis*) and gmelina (*Gmelina arborea*) on a forest soil in south-western Nigeria**. Soil Use and Management 6(1): 43-45.

The properties of soil under 15-year-old plantations of gmelina and teak were compared with logged forest soil in southwestern Nigeria. The concentrations of total N, exchangeable Ca, Mg and K were greater under forest soil, but the concentrations of available P were similar under all three ecosystems.

0167 Adejuwon, J.O; Ekanade, O. 1988. **Soil changes consequent upon the replacement of tropical rain forest by plantations of *Gmelina arborea*, *Tectona grandis* and *Terminalia superba***. Journal of World Forest Resource Management 3(1): 47-59.

Fifteen years after tropical rain forest was replaced by plantations in the Ikere Forest Reserve, Ondo State, Nigeria, most soil properties were n.s.d. from those in rain forest despite significant differences in vegetation characteristics. The plantations, with high tree density and/or ground cover, are thought capable of protecting soil in a similar way to the rain forest.

0168 Adyalkar, P.G. 1973. **Hydrogeological control for teak and sal vegetation in parts of Maharashtra and Madhya Pradesh**. Current Science 42(16): 556-558.

Briefly reports studies since 1969, showing that in the Chandrapur District of Maharashtra, *Tectona grandis* grows well on sandy soil overlying pyroxene gneisses and associated quartz schist with breccias, and with a relatively deep water table.

0169 Akinsanmi, F.A; Akindele, S.O. 1994 . **Teak productivity in relation to soil conditions: A re-assessment of teak plantations in the dry high forest area of southwestern Nigeria.** Nigerian Journal of Forestry 24/25: 7-10.

A re-assessment of teak plantations in the dry high forest area of southwestern Nigeria was carried out by examining the relationship between stand volume and soil properties. Examined the changes which occurred as the plantations advance in age. The results of soil textural analyses showed stability over the years, while slight increases were observed in the organic matter content.

0170 Alexander, T.G; Balagopalan, M; Thomas, T.P; Mary, M.V. 1981. **Properties of soils under teak**. KFRI Research Report 7: 13p. Kerala Forest Research Institute, Peechi.

The project, properties of soils under teak, was started with the objective of evaluating changes in soil properties due to continuous teak cropping. Literature suggests that without proper soil management, clearfelling of natural or plantation forests and monoculture of teak may result in soil deterioration depending on the initial soil conditions, topography, climate and management practices. The profile data reveal recuperation of soil parameters during the long rotation of 60-70 years.

0171 Alexander, T.G; Sankar, S; Balagopalan, M; Thomas, T.P; Mary, M.V. 1984. **Soils in teak plantations of Konni, Naduvathumoozhi and Mannarappara Ranges of Konni Forest Division**. Working Plan for Konni Forest Division 1983-1993, Kerala Forest Department, Appendix: 1-21.

The teak enters into second and third rotations in Kerala. Results are presented of the soil investigation made in teak plantations of Konni, Naduvathumuzhi and Mannarappara ranges of Konni Division with the aim of optimum productivity.

0172 Alexander, T.G; Sankar, S; Balagopalan, M; Thomas, T.P. 1987. **Soil in teak plantations of different site qualities**. KFRI Research Report 45: 17p. Kerala Forest Research Institute, Peechi.

The site quality was calculated based on the height attainable at 50 yr old. Physical and chemical properties determined for different depths. Increases in gravel and exchange acidity and decreases in sand, silt, pH and exchangeable bases resulted in a lower SQ along transects. In a multiple linear regression analysis, soil variables accounted for 31 percent of the variation in top height, and age 63 percent. Partial regression coefficients indicated the important effects of gravel, sand, pH and exchange acidity.

0173 Amir Husni, M.S. 1984. **Detailed reconaissance soil survey of part of Bukit Perangin Forest Reserve and semi-detailed soil survey of Bukit Malut Forest Reserve, Pulau Langkawi, Kedah, for teak crop**. Forest Research Institute, Malaysia, Research Pamphlet 95: 60p.

A survey report on two areas in northern Malaysia where the climate is sufficiently seasonal for teak. The soils in the first area were formed on more or less metamorphosed sediments and granite on hilly lowland terrain, and in the second, less hilly area on Carboniferous sediments. A soil and terrain suitability classification for teak is presented and applied in maps.

0174 Amir Husni, M.S. 1998. **The preliminary performance of teak crop when planted on various soil types in Peninsular Malaysia**.

Malaysian Science and Technology Congress, Kuala Trengannu, Peninsular Malaysia.

0175 Amponsah, G.I; Meyer, W.L. 2000. **Soil characteristics in teak plantations and natural forests in Ashanti region, Ghana**. Communications in Soil Science and Plant Analysis 31(3/4): 355-373.

A study was made to compare soils of natural forests converted to teak plantations in the Offinso and Juaso Forest Districts in the Ashanti region, Ghana. Soil samples from the 0-20 and 20-40 cm depths were analysed for selected chemical and physical properties.

0176 Amponsah, G.I; Meyer, W.L; Murchison, H.G. 2000. **Soil sampling size estimates for soils under teak (*Tectona grandis* Linn.f.) plantations and natural forests in Ashanti region, Ghana**. Canadian Journal of Soil Science 80(2): 327-336.

Sites at Offinso and Juaso Forest Districts in the Ashanti region, Ghana, were used to study the variability patterns for selected physical and chemical properties. In each of three natural forest stands and three teak plantations, 16 soil pits were examined and soil samples from the 0-20 cm and 20-40 cm depths were analysed for selected chemical and physical properties.

0177 Ando, K. 2004. **The current situation of the demonstration study of forest management for carbon fixation**. Tropical Forestry 59: 12-23.

An account is given of a carbon sequestration demonstration study set up at various sites in Java and the species used include *Tectona grandis*.

0178 Arora, R.K. 1964. **The forests of North Kanara district II. Deciduous type**. Journal of Indian Botanical Society 43(1): 75-86.

Presents information on climate, soils, and species composition of teak mixed and bamboo mixed forest. Teak mixed forest flourishes in a comparatively drier climate than bamboo mixed forests. *Xylia* mixed forest has an edaphic status when it occurs in teak mixed forests. The trend of succession appears to be from teak mixed to bamboo/*Xylia*/*Terminalia* forest.

0179 Aweto, A.O. 1995. **Organic carbon diminution and estimates of carbon dioxide release from plantation soil**. Environ-mentalist 15(1): 10-15.

The rates of organic carbon diminution in the soil under different monospecific tree plantations including teak in Nigeria were investigated. The differences between the organic carbon status of their soils and soil under nearby natural rain forest vegetation were compared. The tree plantations released more carbon dioxide from the soil into the atmosphere than the natural forest.

0180 Balagopalan, M. 1986. **Soil properties in selected teak and eucalypt plantations of Trichur Forest Division, Kerala**. Annual Convention of Indian Society of Soil Science and National Seminar on Recent Advances on Soil Research and Special Seminar on Land Evaluation for Multipurpose Land-use Utilization, Coimbatore, September 1986: 2p.

A study was carried out in selected teak and eucalypt plantations of Trichur Forest Division, Kerala. Analysis were done for sand, silt, clay, soil pH, organic carbon, exchangeable bases and exchange acidity. Bulk density and percent of gravel were also determined.

0181 Balagopalan, M. 1987. **Effects of fire on soil properties in different forest ecosystems of Kulamavu, Kerala, India**. Malaysian Forester 50(1/2): 99-106.

A study was conducted to assess the effects of fire on soil chemical and textural properties in semi-evergreen and moist deciduous forests, grassland, and eucalypt and teak plantations. Fire had no noticeable effect on soil texture or pH, but changes were observed in organic carbon, exchangeable bases and exchangeable acidity. Soils in eucalypt plantations had higher organic carbon and lower exchangeable bases but these both decreased in teak.

0182 Balagopalan, M. 1989. **Physical and chemical properties of soils in eucalypt and teak plantations of Trivandrum Forest Division**. Proceedings of the First Kerala Science Congress, Cochin, 26-28 February 1989: 40-43. N.B. Nair, Ed. State Committee on Science, Technology and Environment, Thiruvananthapuram.

This paper highlights the nature and properties of soils in eucalypt and teak plantations of Trivandrum Forest Division. Soils are sandy loam and are strongly to very strongly acidic in the three depths of soils under eucalypt and teak. No pattern is followed in teak plantations in the case of gravel content. Organic carbon contents are relatively higher in eucalypt than in teak plantations. Little difference exists in pH, exchangable bases and exchange acidity of soils under eucalypt and teak.

0183 Balagopalan, M. 1989. **Properties of soils in the natural forests of Trivandrum Forest Division**. National Symposium on Forest Biology in the Service of Mankind and 9th Annual Meeting of Indian Society of Tree Scientists, Madurai, 5-6 January 1989.

0184 Balagopalan, M. 1995. **Changes in the distribution of organic carbon and different forms of nitrogen in soils under natural forest and teak plantations**. Proceedings of the 7th Kerala Science Congress, Palakkad, 27-29 January 1995: 110-112. P.K. Iyengar, Ed. State Committee on Science, Technology and Environment, Thiruvananthapuram.

In the case of plantations, texture was sandy loam in the 0-15 and 15-50 cm layers. Acidity, cation exchange capacity and organic carbon decreased with depth as well as in the sequence natural forest and teak plantations. It has been observed that all properties exhibited significant difference due to vegetational types.

0185 Balagopalan, M. 1995. **Effect of differences in forest cover on the variation in soil properties in Kerala, India**. Journal of Tropical Forestry 11(2): 125-131.

A study was carried out to evaluate the changes in soil properties in moist deciduous forest, anjili, teak and eucalypt, uncoppiced, I coppiced and II coppiced plantations in Kerala, India.

0186 Balagopalan, M. 1995. **Soil characteristics in natural forests and *Tectona grandis* and *Anacardium occidentale* plantations in Kerala, India**. Journal of Tropical Forest Science 7(4): 635-644.

This study was initiated to characterize the soils of natural forests and plantations of different species including teak in the Malayattoor Forest Division of Kerala. Soils in the teak plantation were loamy sand. Soils in the plantations were found to be deteriorated when compared to those in natural forests.

0187 Balagopalan, M; Alexander, T.G. 1983. **Organic matter dynamics in teak and eucalypt plantations**. KFRI Research Report 20: 21p. Kerala Forest Research Institute, Peechi.

An earlier version of a paper by the same authors already noticed by Journal of Tree Sciences 4(2), 1985: 13-20.

0188 Balagopalan, M; Alexander, T.G. 1984. **Soil organic carbon distribution along a transect through teak, eucalypt and albizia plantations in Kerala**. Journal of Tropical Forests 12: 33-37.

This study was initiated to evaluate organic carbon changes along a transect through plantations including teak in Kerala in relation to natural forests. Compared to natural forest, higher levels of organic carbon occurred in teak plantations. F-values were significant for the organic carbon values of locales in the transect.

0189 Balagopalan, M; Alexander, T.G. 1985. **Soil organic carbon distribution along transects in teak and eucalypt plantations**. Journal of Tree Sciences 4(2): 13-20.

Soil samples were analysed from 2.8-km transects along sequences of teak and eucalypt on well drained sites in Kerala. At Thora, a hilly site at 50-100 m altitude, organic carbon values in teak plantations remained close to those in natural forests. At Karulai OC content of the soil decreased along the sequence, which covered only one teak plantation, this is attributed to plantation operations in the early stages of a second rotation.

0190 Balagopalan, M; Chacko, K.C. 2001. **Growth of teak in successive rotations in relation to soil conditions**. KFRI Research Report 201: 26p. Kerala Forest Research Institute, Peechi.

A study was undertaken to examine the changes in soil conditions and evaluate the growth of teak in successive rotations. Gravel and organic carbon contents varied significantly between rotations, while for soil texture, pH, total N, available K and Ca, there was no significant difference between rotations. The discriminant analysis revealed that there was significant decline in soil fertility with change in rotation. The study suggests the need for careful management of the soil to reduce soil deterioration. Site specific soil erosion control measures and proper management of slash, weed and litter are recommended.

0191 Balagopalan, M; Jose, A.I. 1982. **Distribution of organic carbon and forms of nitrogen in soil under mahogany and teak**. Agricultural Research Journal of Kerala 20(2): 16-21.

A study was made on the influence of mahogany and teak vegetation on soil characteristics, namely, pH, organic carbon and different forms of nitrogen. Soils under teak were more acidic than those under mahogany. The content of organic matter decreased with depth. The C:N ratio of the soil was little influenced by depth as well as the type of vegetation.

0192 Balagopalan, M; Jose, A.I. 1982. **Dynamics of organic carbon and different forms of nitrogen under first and second rotation teak plantations of Kerala**. Agricultural Research Journal of Kerala 20(2): 92-97.

A study was conducted in first and second rotation teak plantations in Nilambur, Kerala on soil organic carbon and different forms of N. It was revealed that there was significant reduction in soil organic carbon and all forms of N in all layers of soil pits in the second rotation when compared with first rotation. The C:N ratio in soil under second rotation was found to be narrower as compared to that of the soil under first rotation. The depth-wise and rotation-wise distribution of available, ammoniacal and nitrate forms of N was similar to that of total N.

0193 Balagopalan, M; Jose, A.I. 1993. **Soil humic fractions of red ferrallitic soils as influenced by vegetational types**. Journal of Tropical Agriculture 31: 174-180.

0194 Balagopalan, M; Jose, A.I. 1997. **Effect of tree species on soil properties along a transect through teak, eucalypt and rubber in Kerala**. Teak: Proceedings of the Inter-national Teak Symposium, Thiruvana-nthapuram, Kerala, 2-4 December 1991: 236-241. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department and Kerala Forest Research Institute, Peechi.

A study was carried out to examine the effect of monoculture of teak, eucalypt, and rubber along a transect in Trichur Forest Division, Kerala. Analyses were carried out for particle size separates, soil pH, bulk density, water holding capacity, organic carbon, cation exchange capacity, total N, P, and S. Bulk density was increased, organic matter, N, P, S, and most cation nutrients were depleted in soils under monoculture plantations. Soils under teak were less deteriorated than that under eucalypt.

0195 Balagopalan, M; Rugmini, P. 1989. **Soil characteristics along a transect as influenced by teak plantations in Kerala, India**. Malaysian Forester 52: 67-74.

A study was carried out to find out the effect of teak plantation on soil characteristics in Trichur Forest Division, Kerala. On comparing soil properties in the three vegetational types, it was observed that silt, clay, water holding capacity, total N and S were highest in evergreen soils. Teak soils possessed highest values for sand, soil pH, Fe_2O_3 and Al_2O_3. There was significant difference in Fe_2O_3 and organic carbon contents between teak plantation and natural forests. The study manifests that soils in teak plantations were relatively more deteriorated in comparison to those under evergreen and moist deciduous forests.

0196 Balagopalan, M; Rugmini, P; Chand Basha, S. 1998. **Soil nutrient management for teak plantations of Kerala**. KFRI Research Report 138: 40p. Kerala Forest Research Institute, Peechi.

A project was undertaken to study the effect of different nutrients N, P, K, Ca and Mg on the growth of teak plantations belonging to different rotations. The study revealed that there was significant difference in increment in height of trees in younger plantations while increment in height, basal area and volume of trees in older plantations. Among the different treatments, comparison among means test showed that $N_2P_2K_2Ca_2Mg_2$ treatment was found to be the best in younger plantations.

0197 Balagopalan, M; Thomas, T.P; Mary, M.V; Sankar, S; Alexander, T.G. 1992. **Soil properties in teak, bombax and eucalypt plantations of Trichur Forest Division, Kerala**. Journal of Tropical Forest Science 5(1): 35-43.

Data are presented and discussed on the physical and chemical properties of soils under monocultures of teak and eucalyptus and mixed stands of teak and bombax. Chemical properties differed between plantations. The relatively low values for pH, organic carbon, exchangeable bases and exchange acidity in monocultural teak and eucalypt compared with those in mixed teak and bombax plantations necessitate positive measures in the former plantations to preserve and enhance soil fertility.

0198 Banerjee, A.K. 1973. **Nutritional experiment of *Tectona grandis* in laterite soils of West Bengal**. Silvicultural Conference, 6-10 December 1973, 50. Forest Research Institute, Dehra Dun.

A nutritional experiment of *Tectona grandis* with 5 levels of N, P, and K and with cowdung was taken up in the lateritic area of

West Bengal. Statistical analysis of height growth indicates, that addition of cowdung helps in boosting up of growth. Among the main effects, N. is significant at 1 percent level while NP interaction is also so.

0199 Banerjee, S.K; Nath, S; Banerjee, S.P. 1986. **Characteristics of the soils under different vegetations in the Tarai region of Kurseong Forest Division, West Bengal**. Journal of the Indian Society of Soil Science 34(2): 343-349.

A study of soil properties at three sites under different vegetation, but overlying almost similar parent material in West Bengal, reveals that there is considerable difference among the pedons primarily due to rooting and litter fall characteristics of the perennial vegetation they support. All the soils are acidic. Values of H+ are highest under mixed species, intermediate under sal and lowest under teak. Total bases at the surface soil under teak are highest but under mixed species much lower which may be attributed to differential recycling of elements under different species.

0200 Banerjee, S.P; Mathur, K.C; Prasad, K.G; Raina, A.K. 1989. **Clay minerals in the soils of South Kheri forests, Uttar Pradesh**. Indian Forester 115(8): 555-559.

X-ray diffraction of soil clays from 5 pedons selected in the South Kheri forests demonstrated that kaolinite was the dominant silicate material, both at the surface and sub-surface. In addition, small amounts of goethite, gibbsite and integrated micaceous minerals were identified. It is suggested that the occurrence of vermiculite only in the 3 pedons under natural sal, where it decreased in the sub-surface soil, may only be a coincidence. The other 2 pedons were under *Dalbergia sissoo* and Eucalyptus/*Tectona grandis*.

0201 Barrington, A.H.M. 1931. **Forest soil and vegetation in the Halaing Forest Circle, Burma**. Burma Forest Bulletin (Silviculture) 25.

The suitability of certain soil types for growing teak are given.

0202 Barrington, A.H.M. 1932. **Burma forest soils**. Indian Forester 58(10): 547-555.

In this study, the forest types are correlated in their distribution with F. Charlton's soil texture index number, except on soils with more than 10 percent of $CaCO_3$. Texture of top-soil is observed to influence species distribution and also limit their height growth depending on sharp changes in texture of successive soil-layers. Texture index number classes with site class sub-division and important associated and indicator species are given for the forest types characterised by their dominant species amongst which teak and four other species find place.

0203 Basuki, T.M; Triwilaida; Gintings, A.N. 1996. **Effect of *Hopea odorata*, *Tectona grandis*, *Vatica* sp., and *Hopea mengarawan* on soil properties and nutrient content on the forest floor**. Buletin Penelitian Hutan 601: 65-74.

The effects of *Hopea odorata*, *Tectona grandis*, *Vatica* sp., and *Hopea mengarawan* plantations on soil properties and forest floor nutrient were studied. Soil pH of the stands was acid, with the highest soil pH under *Tectona grandis*. All the stands had a good soil organic matter content, but poor nitrogen and phosphorus contents. *Tectona grandis* showed the lowest uptake of nitrogen and potassium but the highest uptake of calcium. The implications of the results for choice of species on acid soils and fertilizer practices are noted.

0204 Beekman, H. 1917. **Soil and forest**. (Indonesian; English). Tectona 10: 153-175.

0205 Beumee-Nieuwland, N. 1917. **Report on an examination of some soils of marl origin from teak forests**. (Indonesian; English). Tectona 10: 176-203.

0206 Beumee-Nieuwland, N. 1918. **Report on examination of red soils from teak forests**. (Indonesian; English). Tectona 11: 187-205.

0207 Beumee-Nieuwland, N. 1922. **Soil investigations in teak forests in Java**. Meded Proefsta Boschw 8: 92p.

Sets out the results of chemical and physical analysis of teak soils. The majority of the teak forests occur on tertiary lime soils, but some fine stands are found on soils of volcanic origin. The relation of the carbonate of lime content to the nature of the forests is discussed.

0208 Beumee-Nieuwland, N. 1923. **Soil, in teak forests of Java**. International Institute of Agriculture Monthly Bulletin 1(1): 86p.

0209 Bhatia, K.K. 1954. **Calcium a factor in the ecology of teak (*Tectona grandis* Linn.f.)**. Proceedings of National Academy of Sciences, December 1954, Allahabad 24B(4): 159-163.

Values are given for percent ash, CaO and exchangeable Ca in teak foliage from July to January. Ca runs from 3.6 percent which supports the theory that teak is a Cal-ciphyte. Thus the Ca status of forest soils should be considered in teak quality forecasts.

0210 Bhatia, K.K. 1955. **Foliar calcium of teak**. Journal of Indian Botanical Society 34(3): 227-234.

Investigations were made on native teak at Sagar to study: (1) variations in amounts of foliar Ca with respect to soil pH and exchangeable Ca in the soil, (2) variations in the uptake as affected by age, and (3) seasonal variations of foliar Ca. In the first two cases no definite correlation could be established; but a gradual tendency was found for the percentage of foliar Ca to increase with the advance of the growing season.

0211 Bhowmik, A.K; Totey, N.G. 1990. **Characteristics of some soils under teak forests**. Journal of the Indian Society of Soil Science 38(3): 481-487.

Soils of the natural forest of Bori, Madhya Pradesh, are slightly acidic to neutral. Their organic matter content is high at the surface and gradually decreases down the profile. Ca is more recycled than Mg from lower to A horizons. High Ca:Mg ratios in upper layers relative to lower ones indicate the active role of teak in pedogenesis. The soils are classified as Mollisols.

0212 Bloch, P. 1958. **Thailand forest soils**. Natural History Bulletin of the Siam Society 19: 45-55.

The paper describes chemical composition of teak soils. In spite of high clay fraction the soil is well drained, the teak soils have high humus content; 3.39 percent in top layer to 1.07 percent at 1.6 m depth as compared to 1.34 percent in top payer in non-teak soils. The C/N ratio is very low in the deeper layers of teak soils indicating that plenty of N-must be freely available to the roots. The teak soils are typical lateritic soils, and there is good supply of P. which increases with depth.

0213 Boonchai, K. 1965. **Study on the fertility of soils in the teak plantation of Nakorn Rajima**. (Thailand). Student Thesis. Kasetsart University, Bangkok.

The fertility status has not been different in different soils examined and there is no depletion of phosphorous in the soils.

0214 Bruin, J.H.S. 1972. **Development of forest resources, Togo. Soil survey of certain sectors of south Togo**. (French). FAO Report SF-TOG 10, Rapport Technique 4: 160p.

Gives detailed results of a soil survey in several regions where reforestation is envisaged, and discusses choice of location for trial plots and nurseries. Studies are also described on the soil relations of *Terminalia superba* and *Tectona grandis*.

0215 Castens, H.E. 1927. **An investigation of the soil conditions in compartment I, Bwet reserve. Prome division, with reference to the dying of the *Tectona grandis***. Burma Forest Bulletin 18: 14p.

After an examination of soils and forests of teak areas where dying of teak was observed, analysis of dead and living trees and crops, and also ring counting in young taungya areas, the author comments on different soil conditions. Root systems of teak in different soils are described and various soils types are illustrated.

0216 Castens, H.E. 1933. **Soil deterioration in pure teak plantations**. Indian Forest Records (Silviculture Series) 59(10): 656-659.

The difficulties experienced in regenerating old Nilambur teak plantations are discussed and change in soil properties are slow and cannot be easily compared plantation teak with natural teak in view of long rotation and slow process of soil change and development. The author advocates (1) determination of fundamental nature of teak soils, (2) factors determining the quality of teak soils and (3) carry out a large measure soil survey and analysis for both inside and outside teak areas.

0217 Chacko, K.C; Sankar, S; Pandalai, R.C; Nandakumar, U.N. 1989. **Studies on the effect of slash burning on planting site for teak**. KFRI Research Report 61: 21p. Kerala Forest Research Institute, Peechi.

An extensive field trial was conducted at Mundakadavu, Karulai Range, Nilambur Forest Division, Kerala, to study the effect of slash burning on soil properties, weed growth, taungya yield and growth of teak in a second rotation plantation. Burning reduced weed growth during the first three months after planting, but not significantly after this.

0218 Chacko, K.C; Sankar, S; Pandalai, R.C; Nandakumar, U.N. 1991. **Effects of slash burning on soil properties, weed growth, taungya yield and growth of teak**. Indian Forester 117(4): 237-248.

Studies on the effect of slash burning on planting site for teak is studied in which teak was raised in a second rotation plantation with rice and gingelly as the first year taungya crops in Nilambur Forest Division, Kerala. It is found that taungya yields and teak survival and growth were not significantly affected by the different treatments in which involved removal and burning of different sized slash and teak survival and growth was not affected by the practice of taungya. Treatment effects on soil chemistry and weed growth were transitory.

0219 Chamshama, S.A.O; Mugasha, A.G; Sanga, J.M. 2000. **Comparison of some chemical properties of soil under teak and natural forests at Mtibwa, Morogoro, Tanzania**. Journal of Tropical Forest Science 12(1): 92-103.

Soil chemical properties were compared of natural forests and first rotation teak plantations at Mtibwa Forest Project, Morogoro, Tanzania. Soil samples were analysed for pH, electrical conductivity, total N, available P and exchangeable cations. The results of this study suggest that there is a need for continued monitoring of soil chemical properties in teak plantations since there are indications of changes in soil properties.

0220 Chaubey, A.K; Singh, S.B; Prasad, K.G. 1991. **Prediction of soil properties under different forest ecosystems based on discriminant analysis**. Van Vigyan 29(1): 28-34.

An attempt is made to devise model to predict soil properties under four forest types, viz. sal coppice forests, teak dominated sal coppice forests, teak plantations and plantations of mixed species of teak, sal and *Eucalyptus tereticornis* in the lateritic belt of West Bengal. Organic carbon, humus carbon, humic acid, fulvic acid, exchangeable calcium and exchangeable magnesium values from each vegetation community were used to calculate multiple discriminant functions and subjected to cluster analysis.

0221 Chavan, K.N; Kenjale, R.Y; Chavan, A.S. 1995. **Effect of forest tree species on properties of lateritic soil**. Journal of the Indian Society of Soil Science 43(1): 43-46. Oxford & IBH Publications, New Delhi.

It was found that forest tree species including teak in ten-year-old plantations at Wakawali, Maharashtra did not change the soil physical properties under the canopy, but there were marked effects on the soil chemical properties compared with natural forest soils. Organic carbon, available nitrogen, phosphorus and potassium increased significantly in the surface layer. The CEC and exchangeable cations also increased due to the decomposition of organic matter added through leaf litter. Calcium was the dominant cation.

0222 Choldumrongkul, S; Hutacharern, C. 1990. **Study on soil and properties of teak tree in relation to the number of beeholes**. Proceedings of IUFRO Workshop on Pests and Diseases of Forest Plantations, Bangkok, 5-11 June 1988: 149-154. K.G. MacDicken; M.H. Ivory; K.S.S. Nair, Eds.

Sampled trees were measured for girth at breast height. Soil around the sampled trees and their barks were analysed for constituents. The following soil properties exhibited the positive correlation with the beehole class silt, clay, pH, phosphorus, potassium and calcium.

0223 Chongsuksantikun, P; Tantiraphan, W. 1991. **Study on relationship between some soil properties and growth of *Tectona grandis*.** Vanasarn 49(4): 38-41.

Soil properties of individual plots at the depth of 0-18, 18-50 and 50-100 cm were evaluated. Dbh of teak related to soil parameters as follows; pH, available P, exchangeable Ca, base saturation and cation exchange capacity. The better growth of teak of dbh 7.88-11.02 cm was found when the pH of soil was moderately acid to near neutral with medium to very high available P, high to very high exchangeable Ca, medium to high base saturation and high to very high cation exchange capacity.

0224 Choubey, O.P; Prasad, R; Mishra, G.P. 1987. **Studies of the soils under teak plantations and natural forests of Madhya Pradesh**. Journal of Tropical Forestry 3(3): 235-238.

A study was made of soil properties in five teak plantations aged 2-3 to 56 year and in their adjoining mixed natural forests in two edaphoclimatic areas of the state. Surface soil samples were analysed for pH, electrical conductivity, organic C, and available N, P and K. The pH under teak plantations was slightly lower than under the adjoining natural forest; pH under both areas decreased with increasing age of the plantation. Organic C, and N, P and K were higher under the teak plantations than under the adjoining forest, but values of each tended to increase with age of plantation.

0225 Clarson, D; Mythili, S. 1998. **Evaluation of soil fertility status in teak plantations of south India**. Indian Forester 124(2): 146-149.

The available macronutrient status and the physicochemical properties of the soil in commercial teak plantations were evaluated at four sites in Tamil Nadu and one in Andhra Pradesh. The nitrogen, phosphorus and potassium status of the plantations were low to medium, low, and medium to high, respectively. It is suggested that soil fertility evaluation could form the basis for better discriminatory fertilizer recommendation for growing teak plantations in India, so that soil fertility status could be maintained and teak production made sustainable.

0226 Classen, J.C van R. 1909. **Is teak harmful to the soil?** (Indonesian; English). Tectona 1: 575-580.

0227 Contractor, R.M; Badanur, V.P. 1996. **Effect of forest vegetation on properties of a Vertisol**. Journal of the Indian Society of Soil Science 44(3): 510-511.

On the basis of the effects of different tree plantations in the properties of a Vertisol teak, *Acacia nilotica*, *Tamarindus indica* and neem were found the most suitable species for growing in the dry tract of Karnataka, India.

0228 Copleston, W.E. 1919. **Importance of soil aeration for teak**. Indian Forester 45(2): 82-84.

Need and importance of mulching to keep soil free of weeds and plants, to secure loosening and aeration of soil by worms and insects, and to protect seedlings from root competition of weeds and drought following after rains are pointed out as chief advantages.

0229 Dabral, B.G; Pande, S.K. 1980. **Soil moisture regime under forest plantations**. Indian Forest Records, Silvics 3(1): 46p.

Soil samples were taken from plantations of teak, chir and bamboo and under grass, at New Forest, Dehra Dun for testing. Tables and graphs give meteorological data, soil characteristics and various data on soil water. In general moisture content under plantations increased with depth with maximum values in August and minimum values in May. Soil moisture behaviour was similar in chir, teak and sal.

0230 Dabral, B.G; Yadav, J.S.P; Sharma, D.R. 1965. **Soil moisture studies in Chir pine, teak and sal plantations at New Forest, Dehra Dun**. Indian Forester 91(10): 701-713.

Presents data from soil-moisture studies in *Pinus longifolia*, *Shorea robusta* and *Tectona grandis* plantations. Results indicate that the highest soil moisture content were found at 2-3 ft. for teak plantations. It appears that soil moisture is influenced as much by the physical, chemical and biological properties of the soil as by the species growing in it.

0231 Dagar, J.C; Mongia, A.D; Singh, N.T. 1995. **Degradation of tropical rain forest soils upon replacement with plantations and arable crops in Andaman and Nicobar Islands in India**. Tropical Ecology 36(1): 89-101.

The areas cleared for commercial plantation and agricultural use in the islands showed significant decrease in soil pH, organic matter, extractable P and exchangeable K contents and increased bulk density. Nutrient cycling and water balance were negatively affected by the monoculture of commercial plantations including *Tectona grandis* and cultivation of arable crops.

0232 Das, M; Singh, B.P; Khan, S.K. 1997. **Effect of forest tree species on properties of acid alfisol on sloping land in Meghalaya**. Annals of Agricultural Research 18(4): 441-446.

0233 Datta, M. 1996. **Potassium changes in soil upon incorporation of leaf prunings of multipurpose tree species in an acid soil of Tripura**. Journal of the Indian Society of Soil Science 44(3) 398-401.

Water soluble and exchangeable soil potassium initially increased and then declined in the 2-4 months after incorporation of fresh leaf prunings of multipurpose forest tree species at a rate of 10 t/ha. Compared to the control, the initial high free energy values observed in all the leaf prunings, besides Acacia leaves, could indicate enhanced K availability. A similar increase in nutrient potential for K in the soil solution was recorded.

0234 Datta, M; Dhiman, K.R. 2001. **Effect of some multipurpose trees on soil properties and crop productivity in Tripura area**. Journal of the Indian Society of Soil Science 49(3): 511-515.

Growth and yield characteristics are given for twelve multipurpose trees including teak planted at 4 x 4 m spacing.

0235 Davis, P.W. 1940. **Preliminary note on Nilambur soils with special reference to their suitability for teak**. Indian Forester 66: 658-671.

Teak plantations in Malabar, on soils that had borne good mixed forest containing fine teak and with all the indications of a good site for this species, tending to stagnate after a time or even to be invaded by more tolerant species that replace the teak. The soil is of gneissic origin, and the climate, with alternating periods of heavy rain and great heat and drought, presents conditions favourable for the formation of laterite *in situ* on exposure or through any act that reduces the humus content of the soil.

0236 Dhanmanonda, P. 1970. **Determination of aggregate sizes in different ages of plantation at Huay Tak**. (Thai). Faculty of Forestry, Kasetsart University, Thailand, Forest Research Bulletin 12: 21p.

0237 Dhar, B.L; Banerjee, S.P. 1981. **Sand mineralogy of soils under natural teak in Maharashtra**. Van Vigyan 19(1): 14-22.

Analysis of the fine sand fractions of 4 representative soil profiles suggested that the sediments were derived from acid igneous and metamorphic rocks. The soil could not be typified by any particular mineral and the near absence of easily weatherable minerals and abundant concentration of iron ores indicated intense weathering before deposition or during soil formation. Overexploitation of such soil could lead to rapid site degradation.

0238 Dhar, B.L; Jha, M.N; Banerjee, S.P; Kukretee, S.P. 1984. **Clay mineralogy of some teak bearing soils of Maharashtra**. Indian Forester 110(7): 662-672.

Illite and kaolinite have been found to be widespread as major clay minerals in some teak bearing soils of South Chanda Forest Division. It is suggested that kaolinization results in a loss of bases which is not adequately compensated by nutrient cycling. It is therefore necessary to guard against over-exploitation, so as to protect the soil and preserve the ecosystem.

0239 Dhar, B.L; Jha, M.N; Kukretee, S.P. 1988. **Sand mineralogy as an indicator of soil fertility in forest soils under teak (*Tectona grandis*).** Journal of Tropical Forestry 4(1): 47-52.

Four soil profiles under teak were studied for mineralogy of sand fractions by petrographic techniques. Quartz was the most abundant light mineral in all the profiles. Based on the preponderance of various heavy minerals, soil profiles were characterised by tourmaline, epidote/pyroxenes, epidote/tourmaline/biotite and biotite/hornblende/epidote mineral assemblages.

0240 Dhar, B.L; Jha, M.N; Suri, S; Singh, K. 1992. **Minerology and nutrient status of teak-growing soils**. Journal of the Indian Society of Soil Science 40(1): 156-161.

The sand mineralogy and total and available nutrient status of Udic and Typic Ustochrept pedons from Madhya Pradesh were studied and the results are discussed in relation to the growth of teak on these soils.

0241 Dimri, B.M; Singh, S.B; Banerjee, S.K; Singh, S.B. 1987 . **Relation of age and dominance of tree species with soil chemical attributes in Kalimpong and Kurseong Divisions of West Bengal**. Indian Forester 113(4): 307-311.

Soil samples were collected from 1X1 m pedons in 8 plantations of either sal, sal dominated by teak, or teak dominated by sal, age 11-102 year. Soil parent material and topographic and climatic characteristics were similar in all sites. Plants in 40X40 m quadrats were measured for d.b.h. and height Soil samples were analysed for pH, organic matter, extractable Ca and Mg, and N and K. Soil pH varied widely between sites, and attempts are made to relate this to age and species type or mix and to the fact that a greater amount of soil Ca is found in teak sites.

0242 Drechsel, P; Schmall, S; Zech, W. 1989. **Mineral nutrition and soil properties in young teak plantations in Benin and Liberia**. Mitteilungen der Deutschen Bodenkundlichen Gesellschaft 59(2): 691-696.

The nutritional status and growth of young teak plantations was related to soil types and topography. On Ferralsols and Gleysols in Liberia growth and deficiency symptoms were correlated with position on the slope, with slowest growth and most severe dieback occurring on gleyic bottom soils. Vigour of Liberian teak was mainly related to topsoil acidity and the foliar Ca-status on Ferralsols.

0243 Drechsel, P; Schmall, S; Zech, W. 1990. **Relationships between growth, mineral nutrition and soils in young teak plantations in Benin and Liberia**. Water, Air and Soil Pollution 54(1): 651-656.

0244 Edelman, C.H. 1941. **Studies on the soil science of the Netherlands-Indies**. (Dutch). Publ. Stichting `Fonds Landbouw Export Bureau 1916-1918', Wageningen 24 416p.

A comprehensive review of relevant literature comprising chapters on soils of different species. A separate chapter on forest soils dealing mainly with teak stands.

0245 Ezenwa, M.I.S. 1988. **Edaphic factors affecting the growth of *Tectona grandis* on basaltic soils in the derived savanna area of Nigeria.** Geo Eco Tropical 12(1/4): 125-132.

The relationship between soil properties and growth of 11-year old teak was studied on 15 sample plots in plantations at Nimbia, Kaduna State, Nigeria. It was observed that effective soil depth, total nitrogen, exchangeable Ca and K and total exchangeable bases were positively correlated with tree heights and basal areas. The implications of the findings for site selection and forest management in Nigerian savannas are discussed.

0246 Fluyt, P.C.M. 1946. **Notes on forestry in Siam**. (Dutch). Tectona 36(4): 215-230.

Brief general notes on geography, climate and people, followed by an account of the forests of the northern part of the country is given. Teak is claimed to be in its optimum environment and to attain its greatest dimensions in N. Siam. Data on height, clear bole and girth at various ages are tabulated. The teak forests are State owned. Before the war 85 percent. of the exploitation was by European firms, 14 percent by native concerns and only one percent by the Government itself. Increasingly strict regulation has had to be imposed to safeguard the yield. The Brandis Selection System is used as in Burma. Brief notes are included on girdling, felling, transport grading and conversion.

0247 Freezaillah bin Che Yeom. 1965. **Soil survey/assessment for the extension of teak planting in the Chuchok Valley, Mata Ayer Forest Reserve, Perlis**. Malaysian Forester 28(3): 230-239.

Presents the results of a reconnaissance soil survey to assess the area suitable for further planting of *Tectona grandis* in the locality, in view of the success of the existing limited plantations. Relevant literature on teak/soil relationships is listed.

0248 Gangopadhyay, S.K; Banerjee, S.K. 1987. **The influence of vegetation on the properties of the soils of Sikkim**. Proceedings of the Indian National Science Academy. Part B Biological Sciences 53(3): 283-288.

A study of the influence of different tree species including *Tectona grandis* on the characteristics of the soils of Sikkim at 300-1690 m altitude is made. Ash of green foliage, litter and raw humus was analysed for the oxides of elements present to determine the changes taking place during the transformation of green foliage to litter and then to raw humus. It was observed that during the transformation some of the elements like Ca, Mg, K, Na and P were leached out while others like Si and Fe were accumulated.

0249 Gangopadhyay, S.K; Das, P.K; Nath, S; Banerjee, S.K. 1989. **Pedogenic characteristics of the soils supporting different forest vegetation in the Foot Hill Region**. Journal of the Indian Society of Soil Science 37(4): 775-891.

The physicochemical characteristics of soils under different vegetation sequences in the tarai region of Darjeeling district were studied. The soils of the area are mainly Inceptisols, Mollisols and Ultisols. Base saturation of the surface soil is highest under *Tectona grandis*. Haplustolls and Hapludolls represent a better habitat type for the growth of *Tectona grandis*.

0250 Gangopadhyay, S.K; Das, P.K; Nath, S; Banerjee, S.K. 1992. **Forms and distribution of potassium in forest soils of Sikkim**. Indian Journal of Forestry 15(4): 306-312.

Different forms of K were investigated in soils of Sikkim Forest Division under 8 types of forest cover in the lower, middle and upper hills. Soils were acidic and organic carbon and CEC were also high. Data are reported for water soluble, exchangeable, fixed, HCl soluble and lattice K. Content of different forms of soil K varied under different vegetation.

0251 Gangopadhyay, S.K; Nath, S; Banerjee, S.K. 1987. **Nature and properties of some introduced teak (*Tectona grandis*) growing soils of North-West Bengal**. Indian Forester 113(1): 65-72.

Vegetation was studied by quadrate analysis. Numbers of trees were counted, and girth at b.h. and total height recorded. Data are tabulated showing average height, d.b.h., and basal area and tree numbers per ha for each site. Theoretical values for d.b.h. and basal area are also given, based on a diametre growth curve constructed from a yield table for the area. Teak was growing well at all sites, indicating that the soils on them were favourable for the species. The results of physical and chemical analyses of the soils are presented and indicate suitable ranges of various characteristics for optimum growth.

0252 George, M; Gupta, G.N. 1988. **Soil-vegetation relationship in a tropical deciduous forest of Western Ghat**. Journal of Tropical Forestry 4(4): 387-394.

The study area was in Nilgiri North Division, Tamil Nadu, and was grouped into 3 rainfall regions of 750, 750-1500 and 1500-2500 mm p.a. The floristics of each region were studied by quadrate analysis and Importance Value Indices are given for the dominant species. Three different vegetation communities were identified The results are tabulated and indicate that characteristics like soil texture, depth, pH, P, Ca and organic carbon content show significant variation between communities. Maximum depth of the A horizon was recorded in the *Tectona grandis/Anogeissus latifolia* community.

0253 Ghani, Q. 1951. **Effect of teak plantations on the soils of the evergreen and semi-evergreen forests of East Bengal**. Pakistan Journal of Forestry 1(4): 342-347.

The author is of the opinion that the soils in the semi-evergreen forests are in a delicate balance between the two opposing processes of podzolization and laterization and great caution should be exercised before altering the balance by converting the semi-evergreen forest to teak.

0254 Ghani, Q. 1951. **Some problems in the working of the evergreen and semi-evergreen forests of East Bengal**. Pakistan Journal of Forestry 1(3): 204-208.

Discusses difficulties of extraction and utilization of the evergreen and semi-evergreen forests of Chittagong and the Chittagong Hill Tracts and possible disadvantages in the present policy of planting felled areas in this region with teak, both because of the danger of provoking laterization and/or erosion of the soil by substituting deciduous for evergreen cover, and because of the trend towards using more wood as pulp, plywood and fibreboard and less as sawn timber.

0255 Ghare, D.K; Khare, P.K; Mishra, G.P. 1985. **Effects of forest fire on soil nutrient level in a *Tectona grandis* forest stand**. Ecology and resource management in tropics Vol. 1: 71-75. K.C. Misra, Ed. Bhargava Book Depot, Varanasi, India.

0256 Glaser, B; Drechsel, P. 1992. **Relations between available soil phosphate and the foliar phosphate contents of *Tectona grandis* (teak) in West Africa**. (German). Zeitschrift fur Pflanzenernahrung und Bodenkunde 155(2): 115-119.

Studies were made in teak plantations on a wide range of soils in Togo, Benin, Liberia, and Cote d'Ivoire to analyse significant correlations between foliar P and topsoil P contents. Teak trees generally have an adequate P supply with 300-320 kg/ha P and soil depth 15 cm, i.e. above about 150 mg P/kg in stone-free topsoil, in the study region between Benin and Liberia.

0257 Griffith, A.L; Gupta, R.S. 1948. **Soils in relation to teak with special reference to laterisation**. Indian Forest Bulletin 141: 58p.

A general review of the previous literature on the subject is given, which appears to suggest that in teak plantations there occurs a deterioration of the soil with the lowering of the site quality. It has been suggested that laterization of the soil may be one of the factors responsible for this deterioration. The present investigation was undertaken to test the truth of this theory, and find some simple index by which to recognize teak soils.

0258 Gulam Chand; Pathak, T.C. 1972. **Some soil factors in relation to man made forests with special reference to teak**. Proceedings of Symposium on Man-made Forests in India, 8-10 June 1972: III D-49 to III D-53. Society of Indian Foresters, Dehra Dun.

From the field and laboratory investigations of soil from Chittapur, Andhra Pradesh teak plantations, it has been concluded that textural variation in the sub-soil seems to be a significant soil factor responsible for poor growth of 1968 plantation.

0259 Gupta, G.N; Prasad, K.G; Mohan, S; George, M. 1988. **Effect of soil texture and rainfall on stocking and growth of naturally occurring tree species**. Van Vigyan 26(1/2): 35-42.

Soil profile and vegetation studies were carried out in 366 soil pedons and quadrats in Coimbatore Forest Division, Tamil Nadu. The data collected included soil texture, rainfall, numbers of trees/ha for different species and their girth, density and basal area. Five species which include *Tectona grandis* were very sensitive to coarse textured soils and grew better on those of medium texture.

0260 Gupta, R.S. 1946. **Laterisation of soils in teak plantations**. Proceedings of the 7th Silvicultural Conference, Dehra Dun, 1946: 436-444; Indian Forest Bulletin 141, 1947.

0261 Gupta, R.S. 1956. **On the suitability of soils for teak plantations with special reference to laterization**. Proceedings of the 8th silviculture Conference, Dehra Dun, 1951, Part 2: 266-269.

An experiment is conducted to determine the effect of planting pure teak on forest soils with a tendency to laterization. Preliminary results indicate that there is little change in the chemical nature of the soil. In particular, the SiO_2/R_2O_3 ratio, which is the index of laterization of soil, shows the same trends under both natural forest and teak plantation.

0262 Hamilton, J.D. 1927. **Conclusions based on a geological examination of teak-bearing rocks in Burma**. Indian Forester 53(2): 88-91.

After a study of Burma rocks over a decade the author suggested that finer soil of older aluminum are considered home of natural teak, teak is distributed on these deposits and holds and flourishes depending on soil depth. He also suggested conditions required for establishment of teak e.g. soil moisture, soil texture, similar to older alluvium, drainage and correlates distribution of teak to geological formations. The problem of regeneration and effects of fires and calcicolus habit of teak are also discussed.

0263 Hase, H. 1981. **Nutrient reserves in sites of the Caparo Forest Reserve, Venezuela with special emphasis on teak (*Tectona grandis*) plantations.** Gottinger Bodenkundliche Berichte 66: 152p.

Biomass production of the plantations was inversely correlated with clay content of the soil. Nutrient reserves were higher under teak plantations and secondary forest than under natural forest because of nutrient introduction and burning treatments. The former soils contained 90 of the total N, P and Mg reserves and 50-90 of the total K.

0264 Hase, H; Foelster, H. 1983. **Impact of plantation forestry with teak (*Tectona grandis*) on the nutrient status of young alluvial soils in West Venezuela**. Forest Ecology and Management 6(1): 33-57.

Biomass and inventories of macronutrients were determined for ten teak plantations and a mature forest stand which preceded them. Mean tree and stratified random sampling methods of estimating biomass were compared with regression estimates. The average yearly production of biomass per ha of the teak plantations was greater on sites with soils having higher clay contents.

0265 Hoque, S.M.S; Hossain, A.T.M.E; Islam, A.T.M.N; De, H.B. 1989. **Characterization of forest soils of seed orchard and adjoining teak plantation at Hyanko**. Bano Biggyan Patrika 18(1/2): 18-25.

A soil survey was carried out at Hyanko, Chittagong District, Bangladesh to study the soils under seed orchard and the teak and *Gmelina arborea* plantations. The aim was to determine site capability for different forest tree species.

0266 Hosur, G.C; Dasog, G.S. 1995. **Effect of tree species on soil properties**. Journal of the Indian Society of Soil Science 43(2): 256-259.

The influence of tree plantations which include *Tectona grandis* on the properties of red loam soil in Karnataka, India was investigated. Tree planting decreased bulk density and pH whereas soil aggregation, organic matter and exchangeable calcium of the soils increased. The nutrient status of the soils was little changed by tree plantations. The nutrient return through litterfall followed the order Ca N K in teak.

0267 Ikojo, H.A. 1983**. Study of the effect of *Gmelina arborea* (Roxb.) and *Tectona grandis* (L. f.) plantations on the microbial and chemical properties of Onigambari soil. Thesis Summary**. Forestry Abstracts 44(10): 605-606.

0268 Jaski, K.C. 1910. **Is there now any working plan whereby poor soils may be brought under cultivation etc?** (Dutch). Tectona 2: 339-344.

0269 Jenkin, R.N. 1962. **A report on teak soils**. Department of Forest Research, Nigeria, Technical Note 15.

0270 Jeyamala, M; Soman, P. 1999. **Short term changes in soil fertility status in intensively managed teak plantations**. Indian Journal of Forestry 22(1/2): 106-111.

The soil nutrient dynamics was investigated in two of the large experimental teak plantations of Sterling Tree Magnum in Coimbatore, Tamil Nadu during the early period of growth. The plantations were 2.5 and 3 yr old, and changes in the soil chemical characteristics were measured over a 1.5 yr interval. Account was taken of the fertilizers applied and the nutrients returned by litter fall

0271 Jha, M.N; Gupta, M.K; Dimri, B.M. 1999. **Soil organic matter status under different social forestry plantations**. Indian Forester 125(9): 883-890.

A study was conducted in Langha Forest Range, Mussoorie Forest Division, Uttar Pradesh in plantations including teak to determine forest influences on the status of soil organic matter. This study was conducted before and after the monsoon to investigate changes in SOM due to change of seasons.

0272 Jha, M.N; Gupta, M.K; Dimri, B.M; Bedwal, H.S. 1999. **Soil moisture accretion with progressive rainfall under *Tectona grandis* (teak) and Eucalyptus plantations.** Indian Forester 125(4): 392-400.

The gradual accretion of soil moisture with cumulative rainfall was studied at different depths under *Tectona grandis* and *Eucalyptus* plantations in the Langha Range, Mussoorie Forest Division, Uttar Pradesh.

0273 Jha, M.N; Gupta, M.K; Dimri, B.M; Bedwal, H.S. 2001. **Moisture distribution pattern in the soil under different tree plantations**. Indian Forester 127(4): 443-449.

The soil moisture distribution pattern in soil profiles under *Pinus roxburghii*, teak, *Dalbergia sissoo*, *Eucalyptus hybrid* , *Acacia catechu* plantations, *Shorea robusta* and barren land was studied. Soil was loamy sand under teak.

0274 Jha, M.N; Gupta, M.K; Pandey, R. 2000. **Factor analysis of soil nutrient distribution pattern under different plantations**. Indian Forester 126(12): 1270-1278.

Five plantations were selected including teak in the Mussoorie Forest Division, Uttar Pradesh and a factor analysis was conducted to identify the underlying patterns of nutrient and soil chemical properties. The four factor model explained 90 percent of the variance in total P, 85 percent of the variance in organic matter and available N and 70 percent of the variance in total N, total P and total Na, available K and available P. It also explained 62 percent of the variance in available potassium and 66 percent of variance in total Ca.

0275 Jha, M.N; Pande, P. 1980. **Loss of soil moisture as affected by decomposing leaf litter of different forest species**. Indian Forester 106(5): 352-356.

Air-dried soil samples were collected from stands of different species including teak growing on silty clay and clay loams in Uttar Pradesh, and mixed in pots with 10 or 20 percent of the corresponding dried leaf litter. The pots were regularly watered and water loss was measured over 120 days.

0276 Jha, M.N; Rathor, A.K.S. 1984. **Soil organic matter in biomass determinations**. Indian Forester 110(9): 895-900.

Data are presented relating to different species including teak grown at Dehra Dun, showing that soil organic matter is frequently great in proportion to total biomass; available figures range from approximately 17 to 76.5 percent.

0277 Jingsungnern, P. 1967. **Some physical and chemical properties of soil in the natural teak forests of Mae-Huad forest, Nagao, Lampang**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Not much difference was observed in physical and chemical properties of teak grown in good and poor sites, hence these properties cannot be used to classify soil depth.

0278 Joeswopranjoto, S. 1957. **Soil studies on teak forests and teak plantations including physical, chemical and micro-biological aspects in Indonesia**. FAO Teak Sub-Commission, Bandung FAO/TSC-57/24: 4p. FAO, Rome.

In order to correlate the site quality with tree growth in teak forest areas, the chemical, physical and microbiological aspects of forest soils were studies in detail. The termite hill soils and their chemical composition are studied in detail and the future problem of study of teak forest soils and the need for preparation of a soil map for each teak forest division are discussed.

0279 Jose, A.I; Koshy, M.M. 1972. **A study of the morphological, physical and chemical characteristics of soils as influenced by teak vegetation**. Indian Forester 98(6): 338-348.

Describes a study in Kerala of the morphological and physical characteristics of soils in natural forest and in teak plantations on sites formerly occupied by natural forest. The natural forest and the oldest teak plantation had a distinct surface horizon rich in organic matter. The organic matter in soil samples from three different depths down to 180 cm was correlated with the age of the plantations.

0280 Joshi, S.R. 1964. **Character of some Madhya Pradesh forest soils**. Journal of Indian Botanical Society 43(1): 1-8.

The soil profiles of miscellaneous forest are fresh, immature, and rich in minerals; under teak they are immature to slightly mature; and under sal lime-deficient and probably formed by laterization.

0281 Kadambi, K. 1951. **Geology of teak in Mysore**. Proceedings of the 8th Silvicultural Conference, Dehra Dun, 1951, Part 2 (1956): 239-242.

The paper shows how the distribution of teak in Mysore state can be understood by a study of the geology of the areas where it occurs, and how its absence from most parts of Hassan district can be properly explained by studying the nature of the underlying rock.

0282 Kaewcharoen, M. 1965. **Study on soils of different site qualities in teak plantation**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Study of soils from five different site classes based on height 15m, 12-15m, 9-12m, 6-9m and 6m has been done. Soil is sandy loam in all cases and properties of soil are same eventhough teak has different heights.

0283 Kaewla-Iad, T. 1968. **Some physical properties of soil in teak plantations of different ages at Mae-Huat, Lampang**. (Thai). Student Thesis. Kasetsart University, Bangkok.

No differences were observed in physical properties of soil from A and B horizons.

0284 Kaitpraneet, W; Thaiutsa, B. 1975. **Some chemical properties of soil at Klangdong Teak plantation Nakornrachasima province**. (Thai). Faculty of Forestry, Kasetsart University, Thailand, Research Note 15: 11p.

Chemical analysis of 9 samples of surface soil from 1-, 8- and 15-year-old *Tectona grandis* plantations showed that organic matter content increased significantly with age; pH, cation exchange capacity, P, K, Mg and Ca did not vary significantly with age.

0285 Kamala, B.S; Angadi, V.G; Parthasarathi, K; Rai, S.N. 1986. **Symptoms of deficiency of trace elements and the associated changes in peroxidase isoenzyme pattern in the seedlings of teak, mahogany and Eucalyptus**. Van Vigyan 24(3/4): 49-55.

Symptoms of deficiency of copper, zinc, manganese, molybdenum and boron, and the associated changes in the peroxidase isoenzyme pattern are described in seedlings including *Tectona grandis*.

0286 Kaul, O.N; Sharma, D.C; Tandon, V.N; Srivastava, P.B.L. 1979. **Organic matter and plant nutrients in a teak (*Tectona grandis*) plantation**. Indian Forester 105(8): 573-582.

Estimates were made by (a) the mean tree and (b) the stratified tree methods of the DM production and nutrient content of a 0.364-ha plot of teak at Dehra Dun, India. The plot, 38 yr old, had 152 trees of very variable size. Data are tabulated on fresh and dry wt. of leaves, twigs, branches, stem and bark, and the N, P, K, Ca and Mg contents of each. For all quantities, values obtained by (a) were 25-30 lower than by (b): m.a.i. of non-photosynthetic biomass was 2.4 t/ha by (a) and 3.3 t/ha by (b).

0287 Kerbert, H.J. 1909. **Is teak harmful to soil?** Tectona 2(1): 44-46.

0288 Khare, D.K; Khare, P.K; Mishra, G.P. 1982. **Effect of heat on nutrient release from soil under tropical dry deciduous forest**. Japanese Journal of Ecology 32(1): 107-110.

Soil samples from various topographical areas of a tropical dry deciduous forest stand dominated by teak were heated for five minutes at temperatures of 100 or 200 deg C in an oven and at 300, 400, 500 or 600 deg C in a muffle furnace. The samples were cooled to room temperature and analysed. A rapid increase in pH at temperatures up to 200-300 deg C, increases in exchangeable K and Ca and losses in total nitrogen were observed.

0289 Khemnark, C; Wacharakitti, S; Aksornroae, S; Kawelaiad, T. 1972. **Forest production and soil fertility at Nikhem Doi Chiangdao, Chiangmai Province**. (Thai). Forest Research Bulletin 22: 44p. Kasetsart University, Bangkok.

After study of land use policy in dry mixed deciduous forests with teak, recommendations were made on treatment of each forest ecotype to ensure maximum value at maturity.

0290 Khobragade, N; Matte, D.B; Patil, B.N; Gabhane, V.V; Pagar, P.C. 2000. **Effect of plant densities and age of teak on major nutrient status of soil**. PKV Research Journal 24(2): 112-113.

A study was conducted in Nagpur, Maharashtra to characterize the properties of soil under teak plantation having two age groups and different spacing. Closer spacing and age of teak plantation increased the total nitrogen content. Phosphorus content was increased in the narrow spacing. The various spacing and age of teak plantation showed an increase in available potassium.

0291 Laurie, M.V. 1931. **Teak and its lime requirements**. Indian Forester 57(8): 377-381.

The author reports his observations from Annamalai Hills, Madras and offers a testing ground of Hemilton's theory, with alternating patches of magnificent teak and mixed forests and also presents the soil analysis data of the proposed area, which have more uniformity than enunciated by Hamilton. He concludes that lime in itself cannot be regarded as a necessity for good teak growth and physical factor of soil may account for it.

0292 Mapa, R.B. 1995. **Effect of reforestation using *Tectona grandis* on infiltration and soil water retention.** Forest Ecology and Management 77(1/3): 119-125.

This paper reports on the effects of reforestation using teak on infiltration and soil water retention of a Rhodudult in Sri Lanka. Adjacent sites were studied in an area which had been cleared for cultivation over 50 yrs ago. The sites were cultivated and reforested with teak 12 yr ago. Results showed that the afforestation site has the highest steady infiltration rate, due to better soil structure and more macro-pores created by root activity and high organic matter content. The soil water retention was highest in the reforested soil at both depths studied

0293 Marquez, O. 1994. **Mapping soils and evaluation of teak (*Tectona grandis*) plantations in unit II of the Ticoporo forest reserve.** (Spanish). Revista Forestal Venezolana 28(38): 17-23.

Soil types were classified under teak plantations in the western lowlands of Venezuela. Soil fertility was medium to low and drainage was poor. Yield of teak was greatest for plantations on Typic/Fluventic Eutropept soils. These were characterized by a silty loam upper horizon and loamy lower horizons. Teak yield decreased as clay content increased in the soil.

0294 Marquez, O; Hernandez, R; Torres, A; Franco, W. 1993. **Changes in the physicochemical properties of soils in a chronosequence of *Tectona grandis***. Turrialba 43(1): 37-41.

Rehabilitation measures carried out in close cooperation with the local community since 1988 are described in 4230.7 ha of degraded teak forest in Sewu range, South Gombong, Java. The measures involved agroforestry and social forestry techniques. The effect of a teak chronosequence on soil properties was studied in the Ticoporo Forest Reserve, Venezuela. Ca and Mg contents, pH and cation exchange capacity were significantly higher in the soils of the 12-year-old plantation than in the younger plantations

0295 Mohr, E.C.J. 1922. **Samples of soil from several forest districts of the forest service**. (Dutch). Tectona 4: 125-151.

0296 Mongia, A.D; Bandyopadhyay, A.K. 1992. **Distribution of different forms of copper under different vegetations**. Journal of the Indian Society of Soil Science 40(4): 851-853.

Copper was extracted from soil horizons under six kinds of vegetation: evergreen forest, semi-evergreen forest, deciduous forest, rubber, teak and *Pterocarpus dalbergioides* in the Andaman and Nicobar Islands, India. Extractable copper was higher under plantation than natural forest and decreased with depth.

0297 Mongia, A.D; Bandyopadhyay, A.K. 1992. **Physico chemical changes occurring in soils of tropical forest after clearfelling for high value plantation crops**. Journal of the Indian Society of Soil Science 40(3): 420-424.

Soil physicochemical changes that occurred following the replacement of tropical rain forest with high value plantation crops were studied on South Andaman and Little Andaman islands, India. Profile water content, water storage and the water intake rate were lower under teak, red oil palm and *Pterocarpus dalbergioides* compared with virgin forest. Organic matter, Bray's P and available K decreased and bulk density increased when forest was replaced by plantation crops.

0298 Mongia, A.D; Bandyopadhyay, A.K. 1993. **Effect of soil iron and manganese on teak mortality grown in South Andaman**. Journal of the Indian Society of Soil Science 41(1): 199-201.

Reports a study carried out near Tushnabad on the relation between available Fe and Mn of representative soils and teak mortality. Teak mortality was minimum at sites which had a relatively lower available

Fe content in the surface horizon, and a higher content in the subsurface soils; a decrease in the subsurface soil content of available Fe resulted in increased mortality. Teak mortality is related to a decrease in available Fe and Mn, especially in subsurface horizons.

0299 Murthy, M.S. 1971. **Is teak (*Tectona grandis*) a calcicole?** Current Science 40(12): 324-325.

A study of the growth and dominance of teak in eleven associations in Madhya Pradesh in relation to the amount of exchangeable Ca in the underlying soils revealed no evidence that soil Ca plays a decisive role in the growth and distribution of this species.

0300 Murugesh, M; Srinivasan, V.M; Rai, R.S.V; Parthiban, K.T. 1999. **Teak (*Tectona grandis* Linn.f.) on farm land and its effect on soil fertility**. Advances in Horticulture and Forestry 6: 153-161.

Soil samples were collected at depths of 0-15, 16-30 and 31-45 cm from irrigated teak stands, age 6, 8 and 10 years, at the Forest College and Research Institute, Mettupalayam, Tamil Nadu. Soil samples were also collected from a cultivated agricultural field and a barren site. In comparison to both fallow and agricultural soil, increased EC and decreased soil pH were observed under 10-year-old teak. Organic matter and available N, P and K were higher in all teak stands than in the barren site. Exchangeable Ca and Mg were generally greater at all ages of teak than in fallow and agricultural soils. The chemical properties showed similar changes with depth in all soils.

0301 Myers, W.N. 1937. **The assessment of site quality in teak forest soils in connection with soil surveys**. (Dutch). Agriculture School, Wageningen: 156p.

0302 Najib Lotfy, A; Amir Husni, M.S; Suhaimi, W.C; Krishnapillay, B. 2002. **Soil and timber plantations**. A manual for forest plantation establishment in Malaysia: 25-32. Forest Research Institute Malaysia, Kuala Lumpur, Malaysia.

0303 Nath, S; Banerjee, M; Chattoraj, G; Ganguly, S.K; Das, P.K; Banerjee, S.K. 1988. **Changes in soil attributes consequent upon differences in forest cover in a plantation area**. Journal of the Indian Society of Soil Science 36(3): 515-521.

The effect of vegetation change on soil properties was studied in a contiguous area of the Kalimpong Division of West Bengal. There was a significant increase in pH and base saturation of the soil under teak after 12 years. After 28 years, pH and base saturation further increased and thus the soil was transformed from Inceptisol to Mollisol at the order level. pH and base saturation of soils increased under *Tectona grandis*.

0304 Noor, H.M. 2003. **Growth of teak (*Tectona grandis*) on lateritic soil at Mata Ayer Forest Reserve, Perlis.** Journal of Tropical Forest Science 15(1): 190-198.

Teak stumps were transplanted in a lateritic site at Mata Ayer Forest Reserve, Perlis, Malaysia. Maximum height and diameter increments were reached at ages four to five years after planting. Recommendations to improve the survival and productivity of teak grown on lateritic soils are given.

0305 Nwoboshi, L.C. 1972. **Differential influences of two exotic forest tree species on a soil**. Journal of the West African Science Association 17(1): 35-47.

Two young creep soils which in the past were pedologically similar were investigated after a 30 year period under plantations of *Cassia siamea* and *Tectona grandis*. The two profiles were morphologically indistinguishable, but texturally the surface horizons tended to have a crumb structure under cassia and a subangular type of structure under teak. Soil organic matter contents and C/N ratio of both the plantations were also studied.

0306 Nwoboshi, L.C. 1975. **Macronutrient deficiency symptoms in teak (*Tectona grandis* Linn.f.)**. Bulletin, Department of Forest Resources Management, University of Ibadan 6: 12p.

Teak seedlings and stump plants were grown in pots in sand watered with either a complete nutrient solution or solutions complete except for N, P, K, Ca, Mg or S. After 14 weeks, measurements were made of: seedling height and diameter; number and surface area of leaves; dry weight of leaves, stems, roots, the above-ground portion, and the whole plant; and root/shoot and stem/foliage ratios. The general appearance, vigour and leaf colour of the trees were recorded. The results are discussed, and a key based on visual symptoms is given for identifying each major-nutrient deficiency.

0307 Nwoboshi, L.C; Rosswall, T. 1980. **Nitrogen cycling in a teak plantation ecosystem in Nigeria**. Nitrogen cycling in West African ecosystems: 353-361. SCOPE/UNEP International Nitrogen Unit, Royal Swedish Academy of Sciences, Stockholm, Sweden.

0308 Ogigirigi, M.A; Igboanugo, A.B.I. 1985. **Root growth characteristics of some exotic and indigenous tree species in the Nigerian savanna**. Pakistan Journal of Forestry 35(3): 97-103.

Roots were exposed by digging trenches in 3 zones of varying soil type and moisture. Root size and distribution were recorded at 0-30, 30-60, 60-90 and 90 cm deep and beyond. All soil types had a layer of hard iron crust at a depth of 40-60 cm. Roots of *Tectona grandis* was able to penetrate beyond the plinth. Roots of all trees grew better at Nimbia, where the plinth layer was pisolitic, softening in the wet allowing more root penetration than on the other sites where the plinth layers were continuously hard.

0309 Okojie, L.O. 1997. **Bush burning and termite infestation: Implications for environmental accounting in Nimbia Forest Reserve**. Nigerian Journal of Forestry 27(1/2): 37-39.

Investigated the incidence of bush burning in the largest teak plantation in Nimbia Forest Reserve, Nigeria and its impact on termite infestation. A very high and significant correlation was found to exist between bush burning and termite infestation.

0310 Okoro, S.P.A; Aighewi, I.T; Osagie, C.O. 1999. **Effects of selected monoculture plantation species on the humid tropical soils of Southern Nigeria.** Nigerian Journal of Forestry 29(1/2): 73-79.

This study was initiated to investigate the effects of different monoculture plantation species on some soil physical and chemical properties in the lowland rain forest belt of South-western Nigeria. The 28-year-old even-aged contiguous monoculture plantations of *Tectona grandis* along with *Terminalia ivorensis*, *Nauclea diderrichii* and *Gmelina arborea*, including a natural forest as control, were studied. The results showed that the conversion of the natural tropical forest to monoculture species resulted in significant loss of soil calcium and available phosphorus.

0311 Okoro, S.P.A; Aighewi, I.T; Osagie, C.O. 2000. **Effect of selected monoculture plantation species on the humid tropical soils of southern Nigeria**. Indian Journal of Agricultural Sciences 70(2): 105-109.

A study was conducted in 1997 to investigate the effect of different monoculture plantation species including teak on physical and chemical properties of soil in the lowland rain forest belt of southwestern Nigeria. The conversion of the natural tropical forest to monoculture species resulted in significant losses in soil calcium and available phosphorus. The effective cation exchange capacity, pH, magnesium content and texture of the soil were not affected by the respective plantation species. Significant variation of some of the properties with depth was observed for plantation soils.

0312 Osumi, Y. 1979. **Site classification based on soil in northern Malaysia**. Tropical Agriculture Research Series 12: 119-123.

A soil survey was conducted in the Mata Ayer Forest Reserve of Northern Malaysia to assess suitable sites for the establishment of plantations of species including *Tectona grandis* and indigenous tree species. The suitability of each soil unit for the growth of particular tree species is indicated.

0313 Pande, P.K; Sharma, S.C. 1994. **Seasonal variations in carbohydrate activities in soils of some tropical plantations**. Tropical Ecology 35(2): 253-262.

Monthly variations in the activities of amylase, cellulase and invertase were studied in soils under plantations including teak at Dehra Dun, India. Invertase activity was consistently higher throughout the year than the activities of the other two enzymes. Amylase activity was variable.

0314 Pandit, B.R; Chava, S.R.K; Rao, V.V.S.V. 1988. **Differences in chemical properties of soil under different forest covers in two ranges of the South Dangs forest division (Gujarat)**. Advances in Plant Sciences 1(1): 15-20.

Alterations in chemical properties of soils developed on the same slope but supporting different forest associations (teak + *Terminalia tomentosa* at Pimpri and teak + *Dalbergia latifolia* at Chichinagoan) were investigated in the South Dangs forest region, Gujarat.

0315 Pandit, B.R; Prasannakumar, P.G; Jana, C.K. 1997. **Seasonal variations in lead content in Dangs forest, Gujarat**. Advances in Plant Sciences 10(2): 145-148.

Tectona grandis, *Terminalia tomentosa* and *Dalbergia latifolia* were sampled for lead content at 3 sites in Danga forest, Gujarat, India, in the summer, winter and monsoon seasons. Different plant tissues and litter were analysed and lead content in soil at different depths was also determined. Leaves of *Tectona grandis* contained most lead during winter at Chinchinagaon.

0316 Panicker, V.R. 1997. **Tropical soil and teak culture - a new silvi system**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 70-72. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Conolly's plot at Nilambur and Bourdillon's plot at Arienkavu, Kerala, are the living monuments which commemorate the pioneering efforts of Sri. Chathu Menon and Mr. T.F. Bourdilon, in teak culture. The silvicultural system being practised for teak is clear-felling, slash burring and planting. The pre-planting as well as post-planting operations including taungya in teak plantation are largely responsible for the large scale erosion of fertile top soil and thereby deterioration of site quality. A new silvicultural system for teak by adopting modified pre-planting operations, planting, and tending techniques is suggested for improving the soil fertility and reducing the soil erosion.

0317 Paoprachak, P. 1967. **The influence of aspects on soil moisture contents in teak plantations**. (Thai). Student Thesis. Kasetsart University, Bangkok.

N-aspect has significantly more moisture than E, S and W - aspects. Slopes with 3, 6, 9 and 12 percent have significantly more moisture content to 15 percent slope. Moisture content in soil and growth decrease when slope increases.

0318 Parthiban, K.T; Rai, R.S.V. 1994. **Effects of a few plant species on soil physical properties**. Journal of Tropical Forest Science 6(3): 223-229.

Seven multipurpose tree species including *Tectona grandis* raised as woodlots in a farmer's holding at Coimbatore, Tamil Nadu were investigated for their effects on soil physical properties relative to a site without vegetation and to a cultivated soil. Compared with the cultivated field, a degeneration in soil physical properties was associated with tree species. Bulk density increased under *T. grandis*.

0319 Parthiban, K.T; Rai, R.S.V. 1994. **Trees on farmlands - their effects on soil fertility**. Annals of Forestry 2(1): 44-51.

Soil fertility was compared under seven tree species including *Tectona grandis* raised as woodlots on a farmer's holding in Tamil Nadu, and on a vegetationless site and a cultivated field in the proximity. Compared with the uncultivated soil, organic carbon was more under tree species except for *L. leucocephala*. N, P and K under tree cover registered an increase.

0320 Prasad, A; Khatri, P.K; Bhowmik, A.K; Totey, N.G. 1990. **Relationship of teak mortality in Khandwa (Madhya Pradesh) and available soil iron and manganese**. Journal of the Indian Society of Soil Science 38(1): 174-176.

Analytical data are reported and discussed for three soil profiles in one compartment of natural teak forest, each exhibiting different mortality percentages.

0321 Prasad, J; Gaikwad, S.T. 1991. **Site characteristics of soils supporting teak (*T. grandis*) and sal (*S. robusta*) of Mandla District, Madhya Pradesh**. Van Vigyan 29(3): 180-181.

Soil characteristics are described under teak - developed over basalt and sal - developed over gneiss.

0322 Prasad, K.G; Singh, S.B; Gupta, G.N; George, M. 1985. **Studies on changes in soil properties under different vegetations**. Indian Forester 111(10): 794-801.

Soils were sampled in the Coimbatore Forest Region, Tamil Nadu, India below natural forest and teak plantations, 40 yr after conversion. Physical and chemical properties of soil were analysed. Soil organic C, P_2O_5 and Mg concentration were lowest under the teak and intermediate under the mixed plantation.

0323 Prathummanee, Ch. 1961. **Correlation between teak growth during 10 years and the depth of the B-horizon**. (Thai). Student Thesis. Kasetsart University, Bangkok.

After examining soils from 20 pits in teak plantation Mae Huat, Lampang, it is found that the growth of teak is correlated to the depth of B-horizon significantly.

0324 Pricha Dhanm Anonda. 1973. **Site quality of mixed deciduous forest with teak at Mae Huad, Lampang, as determined by soil aggregate**. Forest Research Bulletin, Faculty of

Forestry, Kasetsart University, Thailand 27: 34p.

Site quality was determined from estimates of biomass derived from height and dbh measurements. Soil samples were taken from A and B horizons, and dry-sieved to find the proportion of aggregates in four size classes. No statistical relation could be found between biomass and soil aggregates.

0325 Puri, G.S. 1954. **Soil climate of some Indian forests**. Journal of Indian Botanical Society 33(4): 394-416.

A study was made of soil moisture, organic matter, relative humidity, temperature, pH, and exchangeable Ca in plantations of *Pinus longifolia*, sal and teak in the New Forest, Dehra Dun, and in a grassy area in the open, during the dry summer, monsoon rain, dry winter and rainy winter periods. There were indications of the existence of a relationship between pH, Ca content, temperature and soil r.h. and the tree cover. Highest pH values were found under teak. Lower temperatures at all depths were found in hot weather under teak and sal.

0326 Qureshi, I.M; Yadav, J.S.P. 1977. **Results of some studies on the forest soils of India and their practical importance**. Proceedings of the 11th Silvicultural Conference, Dehra Dun, 15-25 May 1967: 194-203. Forest Research Institute, Dehra Dun.

Notes on work on the soils of dry zone areas, tropical moist evergreen forests, the Himalayan region, various recently afforested areas, forests of *Shorea robusta*, teak and bamboo and *Casuarina* and eucalypt plantations.

0327 Raina, A.K; Banerjee, S.P; Pharasi, S.C; Prasad, K.G. 1990. **Clay minerals in the alluvial sediments in a part of Indo-Gangetic Plain**. Van Vigyan 28(4): 129-135.

X-ray diffraction and chemical data are reported from analyses of five selected clay soils in the South Kheri forests of Uttar Pradesh, three under *Shorea robusta*, one under *Dalbergia sissoo* and one under a Eucalyptus/*Tectona grandis* plantation. Kaolinite was the dominant silicaceous mineral with small amounts of integrated micaceous minerals in the clay fractions.

0328 Ram, N; Jana, M.M. 1997. **Ecological impact of compaction under teak plantation in the foothill of Darjeeling Himalaya**. Indian Forester 123(7): 623-630.

The effects were studied of compaction of the soil under a teak plantation in the Darjeeling Himalayan foothills of West Bengal. Two areas were surveyed one near a village and subjected to compaction by livestock, vehicles, forestry operations, etc. and the other an adjacent non-compacted site. In the compacted area, decreases in height, diameter and basal area of teak were noted.

0329 Ram, N; Patel, S. 1992. **Infiltration capacity of compacted soil under teak plantation**. Van Vigyan 30(2): 77-80.

Measurements made in a 21-year-old teak plantation in West Bengal, where the forest floor had undergone compaction due to excessive biotic interference, gave values for bulk density, porosity, initial infiltration. The intake of water under compacted conditions was less than one third of that of a normal forest floor after a time lapse of 180 minutes.

0330 Rana, B.S; Parihar, A.K.S; Singh, B.P. 2002. **Growth pattern of certain MPTS raised on sodic land**. Indian Forester 128(6): 674-680.

An experiment was conducted in Faizabad, Uttar Pradesh to study the growth performance of thirteen multipurpose tree species including teak raised on sodic land.

0331 Rao, B.R.M; Iyer, H.S. 1981. **Suitability rating of Barnawapara soils for teak plantation**. Van Vigyan 19(4): 115-122.

A soil survey was made in Raipur district, Madhya Pradesh, using 1:15 000 scale aerial photographs and field checks. Physical and chemical properties of the soils, topography, drainage conditions and slope and soil depth were used to rate the soils into four suitability classes. Highly suitable sites included forested crests and side slopes of granitic undulating plain and foot slopes of denudational hills.

0332 Rathod, R; Devar, K.V. 2003. **Effect of different plantations on soil chemical properties**. Karnataka Journal of Agricultural Sciences 16(3): 485-486.

A study was conducted in Karnataka to determine the changes in the chemical properties of soils under plantations of different species including teak. It is found that soil pH was low under all plantations except *A. mangium*.

0333 Rathod, R; Devar, K.V. 2003. **Effect of different plantations on soil physical properties**. Karnataka Journal of Agricultural Sciences 16(3): 487-488.

A study was conducted in Karnataka to investigate the effect of different plantations including teak on soil physical properties such as particle size distribution, texture and bulk density. Results showed that clay fraction was highest in soils under teak. Soil texture was changed form loamy sand to sandy loam under all plantations. Bulk density was the highest under teak.

0334 Rathod, R; Devar, K.V. 2003. **Studies on the exchangeable nutrients of soil under different plantations**. Karnataka Journal of Agricultural Sciences 16(3): 489-490.

The nutrient contents of soils under all plantations and their respective control sites were determined. Results showed that among the exchangeable cations studied, the Ca and Mg contents were higher in soils of all the plantations and control sites. Calcium content was found highest in teak.

0335 Rathod, R; Devar, K.V. 2004. **Available nutrient status of soil under different plant communities**. Karnataka Journal of Agricultural Sciences 17(1): 132-133.

A study was conducted to know the nutrient status of different plantations which include *Tectona grandis* in Karnataka, India. A depletion of nitrogen is reported in soils under teak.

0336 Raweesri, S. 1961. **Correlation between teak growth and depth of A-horizon in Mae Huad teak plantation (1944) Ngao, Lampang**. (Thai). Student Thesis. Kasetsart University, Bangkok.

A highly significant correlation was observed between depth of A-horizon and rate of growth of plantation teak.

0337 Reuysungneun, S. 1961. **Correlation between the depth of A-horizon and teak growth in Mae Huad teak plantation**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The depth of A-horizon is correlated to teak girth significantly.

0338 Rouysungnern, S. 1982. **Some soil physical and chemical changes under tree plantation at Dong-lan reforestation area**. 18p.

Soil properties from up to 20-yr-old plantations were investigated. Soil samples from plots planted with species including *Tectona grandis* were compared with samples from a contiguous unplanted plot. Infiltration and porosity were greatest in the unplanted plot, while in the plantations, soil is compacted and removed the herbaceous layer so the roots were from tree species only.

0339 Sabharwal, L.R. 1938. **Effect of burning of slash on soil and succeeding vegetation**. Indian Forester 63(2): 81-82.

A general paper comparing German experience of adverse effects of mixing ash with that of India and concludes for teak regeneration and dry forest regeneration (Rab method) burning is highly beneficial and essential.

0340 Sachan, R.S; Sharma, R.B; Chibber, R.K. 1980. **Nature and status of organic matter of some forest soils of India as influenced by the heterogeneity of plant cover and climatic conditions**. Indian Journal of Forestry 3(4): 315-319.

Four forest types including teak were studied from different climatic regions of northern India covering 556-1731 m altitude and 93-156 cm annual rainfall. Morphological descriptions of the soil profiles under each are given. The organic carbon content and the quantities and proportions of humic acid, fulvic acid and nonhydrolyzable humins were found influenced by vegetation cover.

0341 Sahu, S; Gupta, S.K. 1988. **Forms of potassium in some soils under forest cover**. Indian Agriculturist 32(1): 23-29.

The results are presented of analyses of four soil profiles from West Bengal under different forest covers including *Tectona grandis*.

0342 Sahunalu, P. 1970. **The estimation of site quality of mixed deciduous forest with teak, Mae-Huad, Lampang as determined by organic matter and nitrogen content of soil**. Proceedings of the 3rd National Forestry Conference, Royal Forest Department, Bangkok: 17p [Forest Research Bulletin 11, 1970: 18p. Kasetsart University, Bangkok].

The study carried out to estimate site quality wherein sampling of soil was done and total height and diameter were measured. A correlation between tree biomass and site quality as represented by N content was observed.

0343 Salifu, K.F; Meyer, W.L. 1998. **Physico chemical properties of soils associated with logged forest and areas converted to teak (*Tectona grandis* Linn.f.). in Ghana**. Commonwealth Forestry Review 77(2): 91-99, 157, 159-160.

Physico chemical properties of soil under two forest covers, logged forest and teak plantation, at 3 locations in the high forest zone of Ghana were compared using one-way analyses of variance (ANOVA). In B-horizons, higher calcium in soils under teak plantations was attributed to the active role of teak in pedogenesis.

0344 Salifu, K.F; Meyer, W.L; Murchison, H.G. 1999. **Estimating soil bulk density from organic matter content, pH, silt and clay**. Journal of Tropical Forestry 15(2): 112-120.

Models for predicting bulk density as a function of easily estimated soil physico-chemical properties were explored for soils under teak plantations. Using data from about 28 soil pedons from Bosomoa, Tain II and Yaya forest reserves in the High Forest Zone of Ghana, multiple regression relationships were developed to predict bulk density.

0345 Salifu, K.F; Meyer, W.L; Murchison, H.G. 2002. **Bulk densities of Ghanaian forest soils in relation to other physico-chemical soil parameters**. Journal of Tropical Forest Science 14(1): 49-60.

Prediction of soil bulk density requires taking several representative volumetric soil samples which is often laborious and difficult, particularly for wet and stony mineral soils. Alternative empirical models to predict bulk density under teak plantations from physico-chemical soil properties are presented.

0346 Sangknenw, N. 1968. **Variation of some plant nutrients in various depths of soil in 0, 2, 4, 6, and 8 years old teak plantations at Mae Huad, Lampang**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The plant nutrients after study of soil pH, organic matter phosphorus and potassium are considered not adequate in different ages, of teak plantations and these soils require fertilization for improvement.

0347 Sankar, S. 1989. **Soils as influenced by slash burning for raising plantations of teak**. Van Vigyan 27(1): 6-11.

Various slash burning and taungya treatments were tested for their effects on soil properties in plots in a finally felled 1926 teak plantation in Nilambur Forest Division, Kerala, which was replanted in 1982. There were 6 treatments: full slash burning, reduced slash burning and no slash burning, all with and without taungya. Measurements are made of pH, exchangeable bases and organic matter.

0348 Sarlin, P. 1963. **The application of forest pedology to afforestation**. (French). Bois et Forests des Tropiques 90: 17-31.

Discusses the causes of unequal success of teak plantations at different positions on a soil catena. It is possible to determine the suitability for teak of a soil in a homogeneous climatic zone by the content of exchangeable bases in the upper horizons and effective rooting depth. Possible use of aerial photos is discussed. Some account is given of studies in progress at the Centre Technique Forestier Tropicale to distinguish the effects of soil and of competition on young plantations.

0349 Sarlin, P. **Soils and teak: Preliminary findings from the study of soils in teak plantations in certain countries of Tropical Africa with special reference to Togo**. FAO Asia Pacific Forestry Commission, Bangkok: 25p.

Includes a note on the use of the 'L.A.P.' luxmeter for measuring relative light intensity.

0350 Seth, S.K; Kaul, O.N; Gupta, A.C. 1963. **Some observations on nutrition cycle and return of nutrients in plantations at New Forest**. Indian Forester 89(2): 90-98.

A preliminary investigation was made, and results are tabulated, of the return of organic matter, leaflitter constituents, return of inorganic nutrients, mineral constituents of green leaf, bark and wood, and estimated total nutrients in standing trees including *Tectona grandis* at Dehra Dun.

0351 Seth, S.K; Yadav, J.S.P. 1958. **Teak soils**. Proceedings of the All India Teak Study Tour and Symposium: 121-137. Forest Research Institute, Dehra Dun.

0352 Shanmuganathan, K. 1997. **Teak plantations and environment**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 259-261. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Tremendous biotic pressure on teak plantations, including cattle grazing, has led to reduced undergrowth, increased run-off, and compaction and erosion of soil. Raising teak on the same sites after each rotation has also contributed to the deterioration of soil fertility. Growing appropriate undercrops after third and fourth thinning and soil fertilization will be useful for retaining the soil moisture and increasing the soil nutrient status. Growing teak plantations following a technical-short rotation, instead of conventional rotation of the maximum volume production, to maintain a sustained yield without any hinderence to the environment is proposed.

0353 Sharma, S.K; Singhal, R.M; Samra, J.S; Banerjee, S.P; Singh, K; Sharma, S.D. 1988. **Study of some difficult sites of Siwalik Forest Division with respect to their management**. Van Vigyan 26(1/2): 15-18.

A study was made of the soil characteristics and vegetation on three sites in the Pathri block of the Siwalik Forest Division, Uttar Pradesh. The soils of the area are of two types, aquic hapludoll and typic haplaquoll. Data are given on the growth of plantations of *Tectona grandis* and *Eucalyptus tereticornis* and a mixed plantation. *T. grandis* display severe mortality.

0354 Singh, A.K; Prasad, A; Khatri, P.K; Singh, B. 1987. **Physico chemical properties of soils developed over gneissic rocks under different forest covers in Nagri Range of South Raipur (Madhya Pradesh)**. Journal of Tropical Forestry 3(1): 37-47.

Analysis of soil samples collected from slopes of 1-3 under a teak plantation with *Terminalia belerica* and *Salmalia malabaricum* and other plantations is made and the results are presented.

0355 Singh, A.K; Totey, N.G. 1985. **Physico chemical properties of bhata soils of Raipur (M.P.) as affected by plantation of different tree species**. Journal of Tropical Forestry 1(1): 61-69.

Soil profiles were examined in plantations of teak, mixed species including *Tectona grandis* as well as on bare ground with ephemeral vegetation but no trees. Physical and chemical properties are tabulated. Soil pH was reduced under the plantations. Higher concentration of organic matter were found under the mixed stand, followed by teak and *P. emblica*.

0356 Singh, A.N; Raghubanshi, A.S; Singh, J.S. 2004. **Impact of native tree plantations on mine spoil in a dry tropical environment**. Forest Ecology and Management 187(1): 49-60.

This study describes the impact of young high density plantations of two native leguminous and one non-leguminous timber tree of *Tectona grandis* species on the soil redevelopment process during the early phase of mine restoration in Madhya Pradesh.

0357 Singh, D; Srivas, N.C; Mannikar, N.D. 1983. **Soil characteristics as influenced by closure of forests of Bundelkhand division and the native vegetation associated with it**. Indian Forester 109(2): 101-110.

Bundelkhand forests are of the tropical dry deciduous type and dominated by teak. They provide fuel, timber and grazing and are managed by coppice with standards. Surface soil samples were collected and analysed for organic C, available P and K, total N, exchangeable Ca and pH. Physical characteristics of the soil were also recorded. Most of the soils were slightly acidic and rich in organic C and available N, P and K. Soil fertility increased with time of forest closure as shown by increased availability of organic C, P and K. Teak was found on acid to neutral soils with a high C: N ratio.

0358 Singh, E.N; Nungchim, A; Singh, S.S; Tiwari, S.C. 2001. **Influence of *Tectona grandis* and Duabanga grandiflora on soil properties in humid tropics of Arunachal Pradesh**. Indian Journal of Forestry 24(2): 135-142.

A study was conducted in Arunachal Pradesh to quantify the amount of litterfall and nutrients returned of teak and kokhon plantations and to evaluate their effect on the physical, biochemical and microbiological properties of the soils in the area. Results showed that there was a general improvement of soil properties.

0359 Singh, J; Gupta, G.N; Prasad, K.G. 1988. **Soil vegetation relationship studies in some selected tree species of Mudumalai Forest Division**. Indian Forester 114(7): 390-398.

The studies were made in the Mudumalai Wildlife Sanctuary on the southern slopes of the Nilgiris in Tamil Nadu. Data were collected on the density and girth of 3 species which include *Tectona grandis* during a soil and vegetation survey of the Division. A total of 53 quadrats at an interval of 1-2 km were analysed; a soil profile was exposed in each and physical and chemical characteristics of the soil horizons are determined. Density and growth of *Tectona grandis* were high on medium textured soils. *Tectona gran-*

dis grew well on soil rich in Ca, Mg, organic carbon and with a higher CEC.

0360 Singh, J; Prasad, K.G; Gupta, G.N. 1986. **Distribution of teak under different silvoclimatic conditions in some parts of the Western Ghats**. Indian Forester 112(11): 1008-1015.

Soil samples were analysed and teak density recorded on sample plots in the Mudumalai Wildlife Sanctuary and in the Coimbatore Forest Division, Tamil Nadu. Results indicated that teak density was higher on medium textured soils on gentle slopes of moderate temperature. Sites with high very high teak density tended to have higher organic C, exchangeable Ca and CEC in the upper soil layers.

0361 Singh, K.P. 1979. **Nutrient and carbon storage in soils of deciduous forests in India**. Geo Eco Tropical 3(1): 35-52.

Soil profiles were taken from five forest stands in the Varanasi Forest Division, Uttar Pradesh, dominated by species including *Tectona grandis*. In all stands, organic C, total N, CEC, exchangeable Ca, Mg, and K and available P were greatest in the soil surface layer, decreasing rapidly with depth.

0362 Singh, K.P; Srivastava, S.K. 1985. **Seasonal variations in the spatial distribution of root tips in teak (*Tectona grandis* Linn.f.) plantations in the Varasani Forest Division, India.** Plant and Soil 84(1): 93-104.

In 19 and 29 yr old plantations on 'red' and 'alluvial' soils, respectively, the seasonal pattern was similar although the alluvial site had a greater number of root tips. Root tip density showed a mid rainy season peak followed by a steady decline after the winter rains. Root tip density decreased with increasing distance from the tree base and with depth in the soil. Soil moisture and rainfall were significantly positively correlated with root tip density.

0363 Singh, K; Banerjee, S.P. 1980. **State of soil aggregation under plantation forests and agriculture in alluvial soil of Doon Valley**. Van Vigyan 18(3/4): 31-38.

Macro-aggregates were preponderant in the surface layers under plantations of *Tectona grandis* of 51.1 percent. Smaller aggregates were present in higher proportions at lower depths.

0364 Singh, P; Das, P.K; Nath, S; Banerjee, S.K. 1990. **Characteristics of teak (*Tectona grandis*) growing soils in the tarai region of West Bengal**. Van Vigyan 28(1/2): 6-15.

A report is given of soil chemical characteristics and clay content for 22 sites with plantations 5-47 yr old. Soils were acidic and contained appreciable amounts of organic C, total N and exchangeable Ca. Height was significantly correlated with total N, cation exchange capacity, exchangeable Ca, and CaO and MgO of surface soil.

0365 Singh, R.B; Mishra, T.K; Banerjee, S.K. 1994. Spatial variability of soil attributes under different community structure of *Tectona grandis* stands in basaltic region. Indian Journal of Tropical Biodiversity 2: 433-440.

0366 Singh, R.B; Prasad, H; Argal, A. 2003. **Spatial variability of soil properties and phytosociological study under different ages of *Tectona grandis* stands in and around Balaghat (M.P.).** Indian Forester 129(12): 1479-1487.

The spatial variability of soil properties and phytosociological study under different age series of plantations of *T. grandis* at Balaghat (Madhya Pradesh) was studied. The effect of trees on soil pH and organic carbon is prominent under older plantations. Sites of older plantations exhibited better soil properties. Species diversity was directly related with soil heterogeneity.

0367 Singh, R; Singh, R.K; Singh, K. 1990. **Effect of different plant covers on soil characteristics**. Indian Forester 116(10): 795-802.

Data are presented and discussed from analyses carried out on samples collected in the Doon valley in northern Uttar Pradesh, from under 6 forest plantations including teak and one agricultural site. The soil at all sites was deep alluvial with a very deep water table. Organic C, total N, available K, exchangeable Mg and cation exchange capacity were also studied. Exchangeable Ca under *T. grandis* was found the highest.

0368 Singh, S.B; Chaubey, A.K; Prasad, K.G; Banerjee, S.P. 1987. **Separation of four ecosystem soils of lateritic belt**. Journal of Tropical Forestry 3(4): 344-348.

Four forest ecosystems of sal coppice forest, sal coppice forest dominated by teak, a teak plantation and a mixed plantation in the lateritic belt of West Bengal were selected for studying soil properties. Mean values of, and relationships between six soil chemistry variables of organic carbon, humus carbon, humic acid, fulvic acid, exchangeable calcium and magnesium were used to distinguish soils of each site on an individual basis. The results of the humic acid analyses and the relationships between humic acid and fulvic acid, humid acid and organic carbon, and fulvic acid and Mg separated the four sites into three groups. It is suggested that multivariate rather than univariate analysis is generally a better method of distinguishing between soils under different vegetation types.

0369 Singh, S.B; Nath, S; Pal, D.K; Banerjee, S.K. 1985. **Changes in soil properties under different plantations of the Darjeeling Forest Division**. Indian Forester 111(2): 90-98.

A study of soil property changes under plantations including *Tectona grandis* and mixed species is made. The pH, organic carbon, CEC, total K_2O and P_2O_5 and clay content of soil in different horizons in each plantation are tabulated, and estimates are also given of exchangeable Ca, Mg, Na and K. The beneficial action of *T. grandis* in recycling Ca is noted.

0370 Singh, S.B; Prasad, K.G; Banerjee, S.P. 1988. **Chemical attributes in soils under different vegetation in semi-arid region**. Van Vigyan 26(3/4): 96-97.

Surface soil samples were taken from adjoining sites of paddy, grape vine, sal, teak and chir pine in Purulia Forest Division, West Bengal. All sites had similar soil parent materials, ground cover and topography. Analyses were made of soil separates, pH, organic carbon, exchangeable cations and available P and K. Available K was highest under teak and sal. CEC at the different sites was closely related to organic carbon and clay contents.

0371 Singh, S.B; Prasad, K.G; Banerjee, S.P. 1988. **Distribution of nutrients in lateritic soils with special reference to vegetation**. Van Vigyan 26(1/2): 24-29.

Lateritic soils from three plantations of species including teak and mixed sal, teak and eucalypts and two natural forests in West Bengal were compared for their physico-chemical properties. The results were interpreted in terms of correlations between soil depth and soil characters. Organic matter was highest in the teak plantation. Exchangeable Ca was also highest under the teak plantation

0372 Singh, T.P. 2003. **Potential of farm forestry in carbon sequestration**. Indian Forester 129(7): 839-843.

Presents a case study in Pilibhit District, Uttar Pradesh on the potential of farm forestry to sequester CO2 and found that trees including teak holds tremendous potential for sequestering and storing carbon.

0373 Somsophon, U. 1961. **Correlation between the depth of soil and the height of teak in Mae Huad teak plantation**. (Thai). Student Thesis. Kasetsart University, Bangkok.

From the data collected a significant correlation was obtained between depth of soil and growth of teak.

0374 Soni, P; Naithani, S; Mathur, H.N. 1985. **Infiltration studies under different vegetation cover**. Indian Journal of Forestry 8(3): 170-173.

Infiltration rates were measured in Uttar Pradesh under plantations of *Pinus roxburghii* (burned and unburned), teak, sal, Eucalyptus, bamboos and in ungrazed but cut grassland. Soil texture, bulk density, percent pore space, soil moisture content and clay, silt and sand content were also recorded.

0375 Srisuksai, B. 1992. **Nutrient losses from teak stump harvesting**. Proceedings of the Seminar on 50 Anniversary of Hyay-Tak Teak plantation, Bangkok, 5-8 August 1992.

Study was conducted to observe soil nutrient losses after harvesting of teak seedlings for stump preparation. The nutrient analysis showed that the total amount of N, P, K, Ca and Mg content in a teak seedling were 3.56, 0.48, 5.38, 1.84 and 0.85 percent of total dry weight, respectively. Conversely, the total amount of N, P, K, Ca and Mg losses from the nursery centre were 16.38, 1.92, 16.96, 6.91 and 3.01 kg/rai (6.25 rai=1 ha).

0376 Srivastava, M.M; Negi, J.D.S; Raizada, A. 1988. **Nutrient accumulation patterns in some man-made forest ecosystems in India**. Advances in Forestry Research in India 2: 221-229.

A compilation of data from various authors on concentrations of major elements (N, P, K, Ca, Mg) in standing plantations of several important species including teak in India, giving values for the constituent above-ground and (in some cases) below-ground parts.

0377 Srivastava, R; Gaikwad, S.T; Ram, J. 1991. **Characteristics and classification of some forest soils of Chandrapur District of Maharashtra**. Van Vigyan 29(4): 234-238.

Eight soil types are described from this area which is dominated by teak and other species.

0378 Sutapak, S. 1968. **Some chemical properties of soil in 0-8 years old Mae Huad teak plantation, Lampang**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Quantity of soil organisms are observed to be more in A-horizon. Soils from teak plantations of 2 and 4 years have more soil organisms than 0, 6 or 8 years old. But no such differences were observed in B-horizon of the soil. The phosphorus in 4 year old is greater than 0, 2, 6 and 8 years and K in 0-4 years is greater than 2, 4 or 8 years plantations. The pH in A-horizon of 4 years old is more than 0, 6 years and no difference to 2 and 8 years.

0379 Suwannapinunt, W; Thaiutsa, B; Kaitpraneet, W. 1975. **Relation between the total soil nitrogen content and the soil organic matter content in Mae Huad Teak plantation, Ngao, Lampang**. (Thai). Faculty of Forestry, Kasetsart University, Thailand, Research Note 13: 13p.

0380 Tang, H.T; Abd Kadir, J. 1979. **An assessment of the teak (*Tectona grandis*) plantations at Mata Ayer Forest Reserve, Perlis**. Malaysian Forester 42(2): 83-95.

Stands on alluvial or alluvial-type wet yellow soils showed a maximum of d.b.h. m.a.i. of 0.58 inches and were superior in all respects to those on lateritic soils. There seems to be potential for expanding the area of teak plantations on alluvial and alluvial-type soils.

0381 Thaiutsa, B. 1968. **The relation between soil and teak**. (Thai). Proceedings of the First Silvicultural Seminar of Royal Forest Department, Ministry of Agriculture, Bangkok R 118: 32-43.

0382 Thaiutsa, B; Khemnark, C; Suwannapinunt, W; Kaitpraneet, W; Chaicharus, S. 1975. **Soil properties of teak plantation after thinning**. (Thai). Faculty of Forestry, Kasetsart University, Thailand, Forest Research Bulletin 37: 27p.

Thinnings were made in an 8-year-old *Tectona grandis* plantation in Lampang at four intensities based on original basal area. The effects on tree growth and soil properties were evaluated after five years. Results showed that the physical and chemical properties of the soil were not significantly different under the different thinning intensities, except for organic matter, which decreased with increased thinning.

0383 Thaiutsa, B; Suwannapinunt, W; Kaitpraneet, W; Sukwong, S. 1976. **Changes of soil properties in teak forest under the different silvicultural systems**. Forest Research Bulletin, Faculty of Forestry, Kasetsart University, Thailand 39: 33p.

Physical and chemical analyses of soils from three silvicultural systems (clear felling, strip felling and selection felling) in the Hae Huad teak forest, Lampang are presented. Soil stability differed significantly between systems: soils from clear-felled areas were more erodible than those from strip-felled or selection plots. Water availability, organic matter and K content increased with increased canopy removal. It is concluded that clear-felling or coppicing methods should be possible for this species, instead of the usual selection system.

0384 Thomas, T.P. 1989. **Effect of varying soil moisture and bulk density on teak, eucalypt and albizia root growth**. KFRI Research Report 58 (Summary): 7p. Kerala Forest Research Institute, Peechi.

Sandy loam surface soil from the Peechi campus of KFRI, Kerala, was used in pot experiments with seedlings of teak, *Eucalyptus tereticornis* and albizia. Soil samples in concrete pots were compacted to three bulk densities of 1.1, 1.4 and 1.6 g/cm3 which corresponded to maximum water holding capacities of 27, 16 and 14 percent respectively. Six-month-old polypot seedlings of the three species were transplanted to the pots and grown for six months. Then they were harvested and measurements of root and shoot length and biomass, and number of leaves and internodal length were taken. Root length in teak seedlings was reduced at soil densities of 1.4 and 1.6 g/cm3. Root biomass was reduced only at a soil density of 1.6 g/cm3, for all species. Shoot length of teak was not significantly affected by treatments, while shoot biomass was slightly higher at soil density 1.4 g/cm3 than at 1.1 g/cm3, but was reduced at 1.6 g/cm3.

0385 Thorenaar, A. 1928. **Fallow land in forestry**. (Dutch; English). Tectona 21: 295-315.

On easily peptisating and heavily eroded grounds it is possible to recover the fertility by using silvicultural fallow. On the soils planting in the silvicultural fallow is recommended, the structure of the first mentioned soil being damaged by taungya, when cultivated during moist weather. To the part fallow belongs, all vegetation besides the main species of trees that maintain and promote the fertility of the soils. The methods of using part fallow are discussed.

0386 Thorenaar, A. 1929. **The furtherance of partial fallow**. Tectona 22: 992-995.

0387 Totey, N.G; Bhowmik, A.K. 1990. **Sand mineralogy of soils of Mohgaon Teak forests, Mandla, Madhya Pradesh**. Journal of the Indian Society of Soil Science 38(2): 361-362.

Mineralogy of fine sand fractions were investigated and related to the growth characteristics of teak [*Tectona grandis*]. All pedons were rich in weatherable minerals like plagioclase, chlorite and hornblende, and their inherent fertility status was rated high. This was reflected by the average girth of teak at breast height.

0388 Totey, N.G; Prasad, A; Bhowmik, A.K; Khatri, P.K. 1992. **Soil productivity as related to radial growth of teak of Seoni and Raipur forests in Madhya Pradesh**. Journal of the Indian Society of Soil Science 40(3): 534-539.

Data from teak sample plots in Seoni and Raipur Forest Divisions were used to compute soil productivity indices from soil physicochemical data. The resulting indices were significantly correlated with radial growth data for teak at 35 and 55-60 yr old. Regression equations showing the relation are given for the two older ages.

0389 Totey, N.G; Singh, A.K; Bhowmik, A.K; Khatri, P.K. 1986. **Effect of forest cover on physico-chemical properties of soils developed on sand stone**. Indian Forester 112(4): 314-327.

Soil samples were collected in mixed stands and in pure plantations of teak and eucalypts in the Kotma and Ghunghuti Ranges in Madhya Pradesh. Weathering appeared to be more rapid under teak than under eucalypts. Ratios of clay to non-clay fractions, the thickness of the A horizon, the percentage organic matter, CEC, pH and exchangeable Ca and Mg were all greater under teak than under eucalypts. The concentration. of soluble salts was greater under eucalypts, followed by teak. Eucalypts performed better in the Ghunghuti Range, while teak grew better in the Kotma Range.

0390 Vahid, S.A. 1927. **An attempt to correlate the geology and forest types of North Chanda Division: Central Provinces**. Indian Forester 53(10): 576-582.

Recognising pure teak and mixed teak types, an attempt is made to correlate forest types with geology and soils of the tract. The author concludes that the best teak is found on Vindhyan sand stones and shales and to some extent on Kamthi and sand stones; good teak occurs on metamorphic rocks when capped with laterite; teak occurs in areas where geological and soil conditions are favourable.

0391 Venekanand. 1931. **Preservation of soil fertility in Indian teak plantation**. Indian Forester 57(2): 91-95; Madras Forest College Magazine September 1930.

Discusses various measures to maintain (1) site preparation and burning, (2) moisture condition of soil, (3) aeration, (4) introduction of leguminous shrubs, (5) maintenance of undergrowth, (6) early closure of canopy, (7) protection from high winds, and (8) protection of humus. The author concludes that absence of regeneration in both natural forest and plantations is due to (a) absence of suitable proportion of organic matter in soil and (b) maintenance of fine tilt over surface permitting moisture availability and movement, and advocates protection of humus from exposed canopy and fires.

0392 Verhoef, L. 1943. **Root studies in the tropics VI. Further data on the oxygen requirement of the root system**. (Dutch). Korte Meded Boschbouw Proefsta 81: 65p.

Describes work, in continuation of Coster's studies (Korte Meded. Boschbouwproefsta., Buitenzorg No. 31, 1932), on 373 species of trees, shrubs and herbs. Some correlation was found to exist between taxonomic groups (families and genera) and O2 requirement, though it is not possible on the basis of this to predict the O2 requirement of individual members of such groups. In general, results for any given species were fairly consistent. Species of the plains tended to have a higher tolerance of O2 deficiency than those of the mountains. Points worthy of special attention are: (1) Godavari Teak was much more resistant to O2 deficiency than other races of *Tectona grandis*. (2) Altingia excelsa showed wide variation in O2 requirements and is suspected on other grounds of representing several races or varieties. (3) Schima noronhae and S. bancana, sometimes regarded as conspecific, differed in their O2 requirements. (4) Species which, owing to high resistance to O2 deficiency, may be worth growing on swampy or heavy soils, are:- *Acacia arabica*, Cassia grandis, Carapa guianensis, Khaya senegalensis, Filicium decipiens, Eugenia lineata, Casuarina junghuhniana, Zizyphus celtidifolia, and to a lesser degree- *Acacia auriculiformis* , Inga laurina, Peltophorum pterocarpum, Anacardium occidentale, Zizyphus jujuba, Manilkara kauki, Mimusops elengi, Eugenia cumini, *Casuarina equisetifolia* and Anthocephalus macrophylla. (5) Of green-manure and cover species, etc., the following have a fairly high resistance against O2 deficiency:- Sesbania sesban, Indigofera galegoides, Aeschynomene americana, Leucaena pulverulenta, Acacia villosa and Thespesia lampas.

0393 Verma, R.K; Totey, N.G. 1999. Biological diversity, medicinal potential of ground flora and improvement in soil quality under plantations raised on degraded bhata land. Advances in Forestry Research in India 20: 37-69.

0394 Vimal, M; Sudhakara, K; Jayaraman, K; Sunanda, C. 2003. **Effect of soil-leaf nutritional factors on the productivity of teak (*Tectona grandis* Linn.f.) in Kerala**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

A study was conducted to identify and assess the nutritional factors limiting productivity of teak plantations of different age groups belonging to different site qualities spread throughout the state of Kerala. The nature of relation between tree growth and the soil/leaf nutrient status and current annual increment in basal area per tree and soil/leaf nutrient status in each age group were investigated. The relation between leaf nutrient status and tree volume was feeble. The models obtained through stepwise regression were all linear in nature and no quadratic terms were present. The critical nutrient concentrations with respect to tree volume do not seem to be attained by the levels of nutrients available in the present data set. It indicates that volume of trees could be increased further by adequate supply of appropriate nutrient elements. The relation between tree growth and nutrient status of soil was stronger compared to the relation between the growth and nutrient status of leaves.

0395 Wachirajutiphong, T. 1968. **The comparison of first log volume and A-horizon depth of Huay teak with Klang-Dong Teak Plantation, 1954-56**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The depth of A-horizon of Klang-dong plot is significant to that of Huay Tak and has more depth, and also the first logs have more volume.

0396 Wanner, H; Soerohaldoko, S; Santosa; Natalia, P.D; Panggabean, G; Yingchoi, P; Nguyen Thi Thuyet Hoa. 1973. **Soil respiration in different types of Southeast Asian tropical rain forest**. Oecologia 12(3): 289-302.

The vegetation varied, according to precipitation and soil type, from lowland to montane rain forest, teak forest, monsoon forest and heath forest. In all the forest types, soil respiration values were of the same order of magnitude and indicated an oxidation of organic matter of 10 - 13 t/ha/year. The difficulties connected with equating soil respiration values and net production of the different forest types are discussed.

0397 Watterston, K.G. 1971. **Growth of teak under different edaphic conditions in Lancetilla valley, Honduras**. Turrialba 21(2): 222-225.

Comparison of four plantations aged 24 and 27 years on alluvial soil indicated that the most important factors affecting the growth of teak were spacing and soil depth. Imperfect drainage on some sites did not appear to affect growth and form.

0398 Xue, L; Kuang, L.G; Chen, H.Y; Tan, S.M. 2003. **Soil nutrients, microorganisms and enzyme activities of different stands**. Acta Pedologica Sinica 40(2): 280-285.

The nutrient concentrations, microorganisms and enzyme activities of soil in *Tectona grandis* stands along with other species were studied. It is found that *Tectona grandis* stands could increase organic matter content and improve the nutrient status of soil.

0399 Yadav, J.S.P. 1968. **Physico chemical characteristics of some typical soils of Indian forests**. Indian Forester 94(1): 85-98.

Describes eleven typical soils under certain important forest types in India. Teak attains best quality on moist soils developed from basalt which is acidic and has adequate amount of exchangeable calcium and availability of phosphorous.

0400 Yadav, J.S.P. 1969. **Soil study for site suitability appraisal of forest plantations in north Bihar**. Indian Forester 95(3): 139-148.

Detailed physical and chemical analyses of soil profiles were made in 1966 in non-calcareous and highly calcareous areas. Average growth data are given for different plantations including *Tectona grandis* and apparent correlations with the soil characteristics are discussed. All the soils are alluvial sands with a relatively finer-textured top layer.

0401 Yadav, J.S.P; Chand, G; Dhar, B.L. 1971. **Mineralogical studies in some soils of North Bihar afforestation areas**. Indian Forester 97(7): 401-405.

Tabulates and discusses the results of field studies in the Champaran and Purnea districts of N. Bihar on the growth of young *Tectona grandis*, *Dalbergia sissoo* and *Dendrocalamus strictus* in relation to the distribution of light and heavy minerals in the various soil profiles. There appeared to be no direct correlation between any particular mineral or group of minerals and growth of the plantations.

0402 Yadav, J.S.P; Sharma, D.R. 1967. **A soil investigation with reference to distribution of sal and teak in Madhya Pradesh**. Proceedings of the eleventh silvicultural conference, Dehra Dun, 15-25 May 1967: 204-215. Forest Research Institute and Colleges, Dehra Dun, India.

Research in 1962 suggested that high values for exchangeable Ca2+ were important in favouring the predominance of teak over other species.

0403 Yadav, J.S.P; Sharma, D.R. 1968. **A soil investigation with reference to distribution of sal and teak in Madhya Pradesh**. Indian Forester 94(12): 897-902.

Data derived from investigations in 1962 indicate that Teak tends to occur on soils with the highest content of exchangeable Ca, *Shorea robusta* on soils with medium Ca content, and miscellaneous species on coarse shallow soils with low Ca.

0404 Zech, W. 1990. **Mineral deficiencies in forest plantations of North-Luzon, Philippines**. Tropical Ecology 31(1): 22-31.

On 3 sites in North Luzon, soil and leaf analyses were carried out to verify whether deficiency symptoms such as chlorosis, dieback of shoots, growth reduction and even breakdown of the trees, are associated with inadequate mineral nutrition. Stunted growth of teak is reported to have been influenced by nutrient deficiencies.

Go top

Litter Decomposition

(See also 0065, 0275, 0372, 0600, 4577)

0405 Asha Sinha. 1992. **Leaching of nitrogen, phosphorus, and potassium from decomposing leaf litter of teak (*Tectona grandis* Linn.f.).** Journal of Potassium Research 8(4): 338-343.

Nutrient leaching from litter leachates was estimated using a new type of apparatus. Leaching was greatest in June and decreased thereafter. Amounts of K in the leachates were greater than those of N and P.

0406 Aweto, A.O. 2001. **Impact of single species tree plantations on nutrient cycling in West Africa**. International Journal of Sustainable Development and World Ecology 8(4): 356-368.

This paper evaluates the impact of plantation monocultures of fast-growing exotic species including teak on nutrient cycling in West Africa. The rates of nutrient uptake and recycling to the soil vary with tree species and ecological zones. In general, single species tree plantations immobilize soil nutrients faster and return less nutrients to the soil than native forest and savanna vegetation. Hence, they deplete soil nutrients.

0407 Bhadoria, H.B.S; Singh, V.P. 1996. **Effect of urea and lime treatments on in vitro dry matter and cellulose digestibility of fallen teak leaves**. Indian Journal of Animal Nutrition 13(4): 220-223.

Proximate composition and tannin content of fallen teak leaves were analysed after treatment with water, water + 4 percent lime, water + 1 percent urea, or water + 4 percent lime + 1 percent urea. Treated samples were evaluated in vitro using rumen fluid. Dry matter and cellulose digestibility, and total volatile fatty acid production were higher in alkali-treated teak leaves; the mixture of lime and urea had an additive effect. There was a reduction in tannin content of the leaves after lime and lime + urea treatments.

0408 Bhadoria, H.B.S; Singh, V.P. 1996. **Physical and nutritive characteristics of fallen teak leaves (*Tectona grandis*) silage**. JNKVV Research Journal 30(1/2): 54-55.

Teak leaf silage was treated with chemicals to improve its physical and nutritive characteristics. pH varied for different silages. Highest concentration of volatile fatty acids of 1.87 percent was recorded in the treatment having urea + lime and lowest of 0.98 percent in the treatment with water. The addition of urea resulted in higher values of total volatile fatty acids.

0409 Bhadoria, H.B.S; Singh, V.P; Singh, N.P. 1996. **Physical and nutritive characteristics of fallen teak (*Tectona grandis*) leaves silage**. Indian Journal of Animal Production and Management 12(2): 117-118.

Chemical composition of fallen teak leaves was analysed after treatment with water, 4 percent lime, 1 percent urea and lime + urea. 750 days of ensiling resulted in the removal of 57.12, 85.68, 64.24 and 89.31 percent tannins. Addition of urea and lime was effective in reducing tannin content; an increase in pH, ammonia-nitrogen, total volatile fatty acids and total N of silages was also observed.

0410 Bhadoria, H.B.S; Singh, V.P. 1997. **Effect of urea and lime treatment on in vitro digestibility of dry matter and cellulose of fallen teak (*Tectona grandis*) leaves**. Indian Journal of Animal Production and Management 13(3): 162-164.

Four treatments (water (T1), water + 4 percent lime (T2), water + 1 percent urea (T3) or water + 4 percent lime + 1 percent urea (T4)) were applied to finely ground teak leaves, collected from a forest in Jabalpur during the autumn. Mean values of in vitro DM digestibility (IVDMD) differed significantly between treatments. All treatments improved IVDMD, but treatment with 4 percent lime and 1 percent urea significantly improved DM digestibility (DMD).

0411 Boquel, G; Suavin, L. 1972. **Inhibition of nitrification by aqueous extracts of litter of *Tectona grandis* and *Melaleuca leucadendron*.** Revue d'Ecologie et de Biologie du Sol 9(4): 641-654.

Aqueous extracts of tropical litter of *T. grandis* and M. leucadendron that had not previously been incubated were found to contain water-soluble compounds showing an antimicrobial influence on (a) Nitrosomonas and (b) Nitrobacter; (a) was more sensitive than (b) to these compounds, the toxicity threshold of which is lower for M. leucadendron than for *T. grandis*.

0412 Boquel, G; Suavin, L. 1974. **Solubilization of iron by two bacteria in the presence of teak litter**. Revue d'Ecologie et de Biologie du Sol 11(2): 187-195.

The solubilization of Fe from ferric oxide and ferrous sulphide in the presence of two bacteria of the genus Bacillus was studied in media containing an aqueous extract of *Tectona grandis* litter from a plantation in Senegal, with or without glucose. The results suggest that teak litter can, in the course of decomposition, initiate processes of Fe migration in tropical soils.

0413 Chaubey, O.P; Prasad, R; Mishra, G.P. 1988. **Litter production and nutrient return in teak plantations and adjoining natural forests in Madhya Pradesh**. Journal of Tropical Forestry 4(3): 242-255.

The study sites were in 20-23 yr old teak plantations and their adjoining natural forests at two sites in Madhya Pradesh. Litter production was 1.5-2.0 percent greater in the teak plantations than in adjoining forest. Showed a greater content of N, P, K and Ca in plantation than in forest litter, indicating a greater nutrient return in the plantations. The results are discussed in relation to published data on litter production in other plantations and natural forests.

0414 Egunjobi, J.K. 1974. **Litter fall and mineralization in a teak *Tectona grandis* stand.** Oikos 25(2): 222-226.

In a monoculture of teak a considerable amount of the annual litter fall fell between December and March. The mean annual litter fall (leaves, seeds plus flowers, twigs) amounted to 9024 plus or minus 882 kg ha-1, of which 90 percent was leaf litter. The nutrient content of the annual litter fall was N 90.9; P 10; K 71; Ca 188; Mg 21.6 and Na 2.1 kg/ha.

0415 Florence, L.M; Methven, I.R. 1997. **Litterfall and leaf decomposition in pure reforestation stands of introduced and indigenous species of Carranglan, Nueva Ecija Province, Philippines**. Asia Life Science 6(1/2): 16p.

Litterfall and leaf decomposition under the stands of teak was studied using the litterfall trap and litterbag techniques along with many other species. Litterfall rate was variable among basal area classes, species and time. Litterfall rate was significantly different among species with *A. auriculiformis* producing the highest litterfall rates in all size classes followed by teak. Nitrogen and the lignin contents of the leaves were found to influence the rates of decomposition.

0416 Geigel, F.B. 1977. **Organic matter and nutrients in litter of various forest trees**. (Spanish). Baracoa 7(3/4): 15-38.

Results are reported of studies at several sites in Cuba, over a 3-yr period, on *Pinus caribaea*, *Hibiscus* sp., *Swietenia macrophylla*, *Tectona grandis*, *Eucalyptus robusta* and *Casuarina equisetifolia*.

0417 George, M; Varghese, G. 1992 . **Nutrient cycling in *Tectona grandis* plantation**. Journal of Tropical Forestry 8(2): 127-133.

Biomass production and nutrient cycling were studied in a 20-year-old teak plantation in Coimbatore forest division, Tamil Nadu. The total biomass production was 180 t/ha and the annual productivity of non-photosynthetic biomass components was 8.69 t/ha. It is shown that *T. grandis* returns more nutrients than it retains and is more efficient in recycling nutrients.

0418 Girolkar, A.K; Naik, M.L. 1990. **Release of nutrients from decomposing leaf litter in artificial and natural forest sites of Raigarh Forest Division**. Comparative Physiology and Ecology 15(1): 38-44.

Measurements were made of litter decomposition and nutrient release (Ca, Mg and N) at two forest sites on hilly slopes in Raigarh Forest Division, Madhya Pradesh. The two sites were natural forest and artificial forest of a teak plantation at Lakha. The amounts of litter and nutrients accumulated after cessation of litter fall at the natural site were greater than in the plantation. Litter decomposition was also more rapid at the natural site. Generally nutrients decreased with decomposition.

0419 Hadimani, A.S; Surya Rao, P; Parvathappa, H.C; Rao, K.R. 1974. **Effects of water-soluble organic substances from different types of leaf and needle litter on the downward movement of manganese in sandy soil**. Plant and Soil 40(2): 365-372.

Describes laboratory studies on the effect of water-soluble extractives from leaves of different species including teak on the movement of Mn in sandy soil. Treatments with citric acid, glucose solution and distilled water were also included. The patterns of Mn distribution in the soil after treatment are described.

0420 Hassan, M.M; Islam, A.T.M.N. 1984. **The contribution of bamboo and some broad leaved species to the soil organic matter content**. Indian Journal of Forestry 7(3): 217-220.

Fallen leaves were collected from four bamboo species and four tree species including teak. Soil organic matter content was monitored over one year after decomposing of the leaves. A seasonal decomposition gradient was found down to 0.75 cm depth and trends were similar for all species. Maximum contributions to soil organic matter content at the stabilized amount found in May would be 31 kg/t soil for *D. indica*, 27 kg/t for *T. grandis* and about 20 kg/t for the other six species.

0421 Hosur, G.C; Dasog, G.S; Satyanarayana, T. 1997. **Litter production and nutrient return of different tree species under plantation conditions**. Indian Journal of Forestry 20(3): 231-235.

Patterns of litter production and nutrient return were studied in plantations of six tree species of 13 to 16 yr old in Dharwad, Karnataka. Litter was collected and separated into different components which were analysed for nutrient concentration, in order to estimate nutrient returns. Litterfall varied from 4099 kg ha-1 in *Tectona grandis* to 8313 kg ha-1 in *Eucalyptus tereticornis*. The contribution of leaf litter to the total litterfall was more than that of other plant parts. Plant parts showed variations in nutrient concentrations, although generally the concentrations of Ca, K and N were higher than those of other nutrients. Teak returned the lowest N, P, K and Ca. Returns of P and Mg were lower in all six species.

0422 Joshi, C.S; Rao, P.B; Singh, R.P. 1997. **Comparative study of litter fall and nutrient return in some plantations of Central Himalaya**. Proceedings of the Indian National Science Academy. Part B. Reviews and Tracts Biological Sciences 63(6): 617-624.

The pattern and the amount of litter fall and nutrient return to the soil in nine plantations of six tree species which include teak, were studied in Uttar Pradesh. The results are compared among the plantations and with published data for natural forests of the region. The leaf litter contributed a major portion of 76-98 percent of the total litter production. The regressions between species and time with abiotic factors like evaporation, rainfall, temperature and wind speed showed 30 percent variability in litter production in different plantations.

0423 Joshi, C.S; Singh, R.P; Rao, P.B. 1999. **Pattern of leaf litter decomposition in forest planta-**

tions of Tarai region in Uttar Pradesh, India. Tropical Ecology 40(1): 99-108.

Leaf litter decomposition in tree plantations include *Tectona grandis* was studied in the Tarai region of Central Himalaya to examine: (i) the rate and seasonal pattern of decomposition, and (ii) the relationship between rate, litter quality and environmental factors. The upper layer of the soil is rich in organic carbon of 2.6-6.3 percent and potassium of 347-517 kg ha-1.

0424 Jung, G. 1971. **The influence of anaerobic and aerobic incubation on the composition of water-soluble extracts of tropical litters**. Occology Plant 6(4): 297-317.

Gives the results of experiments with litter of *Acacia albida, Guiera senegalensis* and *Tectona grandis*. The water-soluble extract of *T. grandis* had high amounts of aliphatic and phenolic acids. The decomposition of water-soluble organic compounds was greater in aerobic than in anaerobic conditions. During anaerobic incubation, acidification of the water-soluble extracts took place, with the production of considerable amounts of lactic and succinic acids, resulting from anaerobic fermentation. During aerobic incubation the pH of water-soluble extracts rose rapidly, the easily-decomposing litters producing the most alkaline extracts.

0425 Kenjale, R.Y; Chavan, K.N; Chavan, A.S. 1994. **Recycling of nutrient elements by some forest tree species of Konkan in Maharashtra. II Leaf litter decomposition and release of nutrients in lateritic soil of Konkan**. Van Vigyan 32(1/2): 7-14.

The decomposition and release of nutrients into the soil from leaf litter of seven forest tree species was studied in the laboratory. The study showed that available N, P_2O_5, K_2O and exchangeable Ca and Mg were significantly higher in soil mixed with leaf litter than in barren soil. There were differences between species with respect to release of the different nutrients studied.

0426 Kotwal, P.C; Mall, L.P. 1977. **Litter production and disappearance in tropical dry deciduous forests near Ujjain, M.P**. Annals of Arid Zone 16(1): 111-116.

Quantitative studies were carried out on litter production by seventeen important tree species which include teak of a tropical dry deciduous forest stand in Madhya Pradesh. The amount of litter contributed by each species manifested their dominance in the stand, and the total amount indicated the stocking density. The litter fall showed autumnal peak and except for some non-leaf litter, almost completely disappeared by the next season of litter fall. This favours rapid nutrient recycling.

0427 Krishnakumar, A.K; Gupta, C; Sinha, R.R; Sethuraj, M.R; Potty, S.N; Eappen, T; Das, K. 1991. **Ecological impact of rubber (*Hevea brasiliensis*) plantations in north east India: 2. Soil properties and biomass recycling**. Indian Journal of Rubber Research 4(2): 134-141.

The influence of rubber and teak plantations and natural forest on soil properties, nutrient enrichment, understorey vegetation and biomass recycling was studied at three sites in the Siliguri subdivision, Darjeeling district of West Bengal. All three sites had high input of organic carbon enriching the soil. Teak had the highest organic matter content in the surface layers. The depletion of organic carbon with depth was highest for teak and least for natural forest. The results suggest that the depletion of sub-surface soil moisture would be less under rubber than teak. The soils under teak showed a higher calcium content in the surface layers.

0428 Kumar, B.M; Deepu, J.K. 1992. **Litter production and decomposition dynamics in moist deciduous forests of the Western Ghats in Peninsular India**. Forest Ecology and Management 50(3/4): 181-201.

A field study was conducted in the moist deciduous forests of Thrissur Forest Division, Kerala, to test three hypotheses: (1) litter production in tropical forests is a function of floristic composition, density, basal area and disturbance intensity; (2) decay rate constants of tropical species are an inverse function of initial lignin/nitrogen ratio; and (3) decomposition rates in tropical forests are faster than those of temperate forests. Leaf litter decay rates for six dominant tree species including *Tectona grandis* were assessed. In general, less disturbed sites and species adapted to higher nitrogen availabilities exhibited relatively higher decay rate coefficients. *Tectona grandis*, *D. pentagyna* and *Terminalia paniculata* exhibited slower rates of decomposition. Mean concentrations of N, P and K in litter were very variable amongst the dominant species.

0429 Maity, S.K; Joy, V.C. 1999. **Impact of antinutritional chemical compounds of leaf litter on detritivore soil arthropod fauna**. Journal of Ecobiology 11(3): 193-202.

The rate of colonization and succession of soil microarthropod groups were compared with respect to antinutritional chemical parameters in the leaf litter of twelve different tree species under controlled field conditions. The initial colonization was high in *Tectona grandis*, *Casuarina equisetifolia*, *Anthocephalus chinensis*, *Cassia siamea* and *Acacia auriculiformis* . Regarding the impact of antinutritional factors, the initial colonization was high in leaf litter with less initial amounts of polyphenols and tannins. Similarly, leaf litter with minimum initial amount of lipids and lignins showed a gradual increase in the colonization rate of microarthropods. The colonization of microarthropods demonstrated their significance in trapping energy and nutrients from fast decomposing litter and suitability of some litter types in enhancing biological activity in soil.

0430 Mary, M.V; Sankaran, K.V. 1991. ***Ex-situ* decomposition of leaf litters of *Tectona grandis*, *Eucalyptus tereticornis* and *Albizia falcataria***. KFRI Research Report 71: 41p. Kerala Forest Research Institute, Peechi.

From plantations in Kerala.

0431 Naik, M.L; Shrivastava, B.K. 1985. **Leaf litter fall in the forests of Surguja (Madhya Pradesh)**. Journal of Tropical Forestry 1(2): 140-144.

Litter was collected and base area, stand age and density were recorded in teak plantations and in natural sal stands. Litter measured was higher in the plantations than in the sal stands. A similar difference was also found between litter per unit base area in the two kinds of stands. Leaf litter was positively correlated and showed a parabolic relation with base area.

0432 Nisharaj, S; Paulsamy, S; Sekaran, S. 2003. **Litterfall and nutrient return in four tropical deciduous forests of Western Ghats**. Myforest 39(1): 25-30.

Litterfall and nutrient return were studied in four deciduous forests including *Tectona grandis* plantation of Kerala. Total litterfall was the lowest in Tectona of 4492 kg/ha when compared to *Bambusa bambos*, *Dalbergia latifolia* and *Terminalia paniculata*. The return of nitrogen and potassium was least in the *Tectona* forests.

0433 Panda, A; Swain, S.L. 2002. **Leaf litter decomposition of teak, acacia and eucalyptus in plantation forest of Orissa**. Journal of Ecobiology 14(3): 223-231.

Decomposition of leaf litter of *Tectona grandis*, *Acacia auriculiformis* and *Eucalyptus hybrid* in Orissa was studied using litter bag technique. The decay rate of teak litter was higher than that of Acacia and Eucalyptus. Decomposition constant was observed to be maximum in teak litter of 1.15 and minimum in Eucalyptus litter of 0.47. The release of carbon from teak litter was 39 g percent.

0434 Pande, P.K. 1999. **Litter decomposition in tropical plantations: Impact of climate and substrate quality**. Indian Forester 125(6): 599-608.

Using the litter bag method, the decomposition rate was studied of the litter of four plantation species, which include teak in relation to their chemical composition and climatic factors. Leaf litter decomposition constants followed the order : sal 1.67 teak 1.65 pine 1.35 eucalypts 1.34. Invariably, rainfall, number of rainy days, soil moisture and temperature showed positive correlations with decomposition rate. Multiple correlation analysis showed that the cumulative effect of rainfall and temperature was also positively significant. As far as chemical constituents of litter were concerned, N and Mg contents were positively related to decomposition rate while lignin and holocellulose contents and the lignin/nitrogen ratio showed a negative correlation.

0435 Pande, P.K. 2004. **Nutrient cycling in disturbed tropical dry deciduous teak forest of Satpura Plateau, Madhya Pradesh, India**. Journal of Tropical Forest Science 16(1): 94-105.

Distribution of different nutrients in different life forms, their allocation in different tree components and nutrient cycling in teak forests of Satpura Plateau are described.

0436 Pande, P.K; Meshram, P.B; Banerjee, S.K. 2002. **Litter production and nutrient return in tropical dry deciduous teak forests of Satpura plateau in central India**. Tropical Ecology 43(2): 337-344.

The study deals with quantification of litter production, seasonal variations in litter nutrient concentration and nutrient return to the forest floor as influenced by insect defoliation and past disturbances in some tropical dry deciduous teak forests of Satpura plateau in Chhindwara forest division in Madhya Pradesh.

0437 Pande, P.K; Sharma, S.C. 1986. **Seasonality and pattern in leaf-fall and litter accretion on the forest floor in plantations of Dem-**

onstration Area, Forest Research Institute & Colleges, Dehra Dun. Indian Forester 112(4): 328-341.

Litter samples were collected from plantations of *Tectona grandis* along with plantations of many other species. Leaf fall over the year was 5009.44 for *T. grandis*. Maximum leaf fall was in April-May for teak.

0438 Pande, P.K; Sharma, S.C. 1988. **Litter nutrient dynamics of some plantations at New Forest, Dehra Dun**. Journal of Tropical Forestry 4(4): 339-349.

Measurements were made of nutrient return, release and accumulation in plantations of sal, teak, and pine and eucalypts. In general nutrient release followed the order Ca N K Mg P for teak and sal. Leaf litter contributed the most nutrient return, release and accumulation. Nutrient return followed the pattern of litter fall, whereas release depended on nutrient return and litter decomposition rate.

0439 Pande, P.K; Sharma, S.C. 1993. **Biochemical cycling and nutrient conservation strategy in some plantations**. Indian Forester 119(4): 299-305.

Monthly measurements of litterfall were made in permanent litter plots set up in four plantations in the demonstration area of New Forest, Dehra Dun, Uttar Pradesh. The plantations were of sal, teak, pine and eucalypts. Data are tabulated on the monthly and annual conservation of the major nutrients of N, P, K, Ca, Mg present and on annual nutrient return. In general, teak and sal conserved more nutrients than pine and eucalypts and conservation of N and P was greater than that of other nutrients.

0440 Pande, P.K; Sharma, S.C. 1993. **Litter decomposition in some plantations**. Annals of Forestry 1(1): 90-101.

Litter decomposition of four tree species including teak was studied in plantations using the litter bag method. Litter dry weight loss was determined monthly. Data are presented on the characteristics of the plantations such as average diameter at breast height, trees/ha, annual litterfall, and annual biomass production and the litter decomposition data analysed. Values for litter decomposition constants, and times required for loss of 50 and 95 percent litter dry weight are tabulated. Leaf litter decomposition followed the order sal teak pine eucalypts while for twig litter decomposition, the order was teak sal pine eucalypts.

0441 Pandit, B.R; Prasannakumar, P.G; Jana, C.K. 1998. **Seasonal variations in total nitrogen percentage in two different forest ecosystems in Gujarat**. Advances in Plant Sciences 11(1): 165-169.

Data are presented on the seasonal variation of nitrogen in the soil and litter of three tree species of *Tectona grandis*, *Dalbergia latifolia* and *Terminalia tomentosa*. Soil N contents varied with season and depth. The percentage of N in litter showed an increasing trend from summer to winter.

0442 Pandit, B.R; Rao, K.V.R; Subrahmanyam, S.V.S. 1992. **Litter production and chemical properties of soil in two ranges of Western Gir forest, Gujarat**. Indian Botanical Reporter 10(1/2): 28-33.

In forests dominated by teak.

0443 Pandit, B.R; Subrahmanyam, S.V.S; Rao, K.V.R. 1993. **Leaf litter production of the dry deciduous forest ecosystem of eastern Gir (Gujarat)**. Indian Forester 119(5): 375-380.

Monthly data on leaf litter production of major forest species including teak were collected using litter traps at five sites in the Gir forest. Data on floristic composition are given for all sites. Litterfall was the greatest in February and at the teak site. Litter production was generally proportional to tree density.

0444 Pradhan, I.P. 1973. **Preliminary study of rainfall interception through leaf litter**. Indian Forester 99(7): 440-445.

Leaf litter of *Tectona grandis* (a), *Dendrocalamus strictus* (b), *Albizia lebbek* (c), *Dalbergia sissoo* (d) and *Acacia arabica* (e) was placed on wire-mesh trays in the open at the Soil Conservation Research Farm, Vasad. Subsequent measurements showed that interception was greater in teak and declined in the order (e) (d) (b) (c). During the rainy season, litter decomposition was greatest for teak and least for acacia.

0445 Prasad, R; Mishra, G.P. 1985. **Litter productivity of dry deciduous teak forest stands of Sagar (Madhya Pradesh)**. Indian Forester 111(6): 359-367.

Litter sampled from these forests from 15th April to 15th May has been taken as the total annual litter production, considering locality factors and the species. Total annual litter production was found to be 4.959 t/ha of which teak contributed 37 percent, *Terminalia tomentosa* 8 percent, *Diospyros melanoxylon* 4 percent, *Butea monosperma* 6 percent and Miliusa tomentosa 3 percent.

0446 Rangarajan, T.N; Paulsamy, S; Arumugasamy, K; Murugan, A; Sekaran, S. 1997. **Litter dynamics and efficacy of certain variables on the rate of decomposition in a 40-year old teak forest, Western Ghats**. Van Vigyan 35(1): 5-13.

Litter fall and decomposition were investigated in a 40-year-old teak forest in Tamil Nadu. Total litter production was 10 321 kg/ha over the year and varied from 12.2 to 238.9 g/m2. Leaves contributed 69.79 percent, twigs 13.33 percent, bark 2.84 percent and other parts 13.98 percent. Of the soil and litter variables analysed (soil pH; soil and litter moisture; litter C:N ratio, lignin, water soluble compounds, bacteria, actinomycetes and all fungal species) significant positive relationships were found between decomposition and soil and litter moisture, litter C:N ratio and litter actinomycetes. The total number of fungal species was negatively related to decomposition.

0447 Rao, B.K.S; Dabral, B.G; Pande, S.K. 1972. **Litter production in forest plantations of chir (*Pinus roxburghii*), teak (*Tectona grandis*) and sal (*Shorea robusta*) at New Forest, Dehra Dun.** Tropical Ecology: Proceedings of the Symposium, New Delhi, January 1971: 235-243.

On the basis of 100 trees, the annual litter accumulation was 1396 kg/ha under chir, 1167 kg/ha under teak and 743 kg/ha under sal. Stand density and age were found to be the major factors determining litter production, while precipitation and wind significantly affected litter fall.

0448 Rao, K.V. 1997. **Decomposition of teak leaf by some fungi**. Journal of Mycology and Plant Pathology 27(1): 51-54.

The role of Acremonium terricola, Chaetomium globosum, Fusarium scirpi, Gliocladium sp., Gleomastrix murorum, Myrothecium roridum, Phoma sp., Pithomyces maydicus, Scolecobasidium constrictum and Syncephalastrum racemosum in the decomposition of leaf discs of teak was studied. G. murorum, Phoma sp., P. maydicus and S. racemosum were the most efficient decomposers of teak leaf discs. There was a positive correlation between the activity of different hydrolytic enzymes and the rate of decomposition.

0449 Rao, K.V. 2001. **Production of dextrinizing amylase by three teak leaf litter decomposing fungi**. Perspectives in biotechnology. Proceedings of a National Symposium, Warangal, 26-27 February 1999: 171-174. S.M. Reddy; D. Rao; Vidyavati, Eds. Scientific Publishers, Jodhpur.

Amylase production by three teak leaf litter decomposing fungi, *Gliocladium* sp., *Heterocephalum aurantiacum* and *Phoma leveillei* in different synthetic media was investigated. *Gliocladium* sp. was an efficient producer of amylase in starch supplemented medium. Amylase production increased with the increase in starch concentration. *Gliocladium* sp. and *P. leveillei* achieved maximum vegetative growth in starch medium. *H. aurantiacum* preferred starch supplemented with $CaCl_2$ medium.

0450 Rathod, R; Devar, K.V. 2003. **Pattern of litter fall and contribution by various litter components to the total litter under various forest plantations**. Karnataka Journal of Agricultural Sciences 16(3): 491-493.

This study was conducted to quantify the amount of forest litter and to assess the contribution of various litter components to the total litter under various forest plantations including teak. Among the litter components, leaf litter contributed maximum in all four plantations.

0451 Rathod, R; Devar, K.V. 2004. **Litter production and nutrient return in plantations of four tree species in Karnataka State**. Karnataka Journal of Agricultural Sciences 17(1): 68-71.

Studies on litter production and nutrient return in plantations of tree species including teak growing at Terakanahalli forest, Sirsi Forest Division, Karnataka, India were carried out.

0452 Sanit Aksornkoae; Choob Khemnark; Tawee Kaewla iad. 1972. **Study on organic matter in teak plantation**. (Thai). Faculty of Forestry, Kasetsart University, Thailand, Forest Research Bulletin 23: 41p.

Tree growth, litter fall and rate of decomposition, soil properties and soil microorganisms in five teak plantations were studied. Results showed that growth differences between burned and unburned plots were not significant; litter fall was high in March and April, with maximum decomposition in April-September, differences between soil physical properties were in general insignificant, but N, P, K and Ca content and organic matter were significantly different.

0453 Sankaran, K.V. 1993. **Decomposition of leaf litter of albizia (*Paraserianthes falcataria*), eucalypt (*Eucalyptus tereticornis*) and teak (*Tectona grandis*) in Kerala, India.** Forest Ecology and Management 56(1/4): 225-242.

Ex situ decomposition of leaf litter of *P. falcataria*, *E. tereticornis* and *T. grandis* was studied under field and laboratory conditions using the litter bag technique. The amount of CO_2 evolved from the decaying litter and the associated populations of fungi, bacteria and actinomycetes were quantified. A laboratory study was also conducted to determine the amount of organic carbon added to soil during decomposition. *T. grandis* litter decomposed rapidly compared with the others.

0454 Sankaran, K.V. 1994. **Fungi associated with the decomposition of teak and Albizia leaf litter in Kerala**. Indian Forester 120(5): 446-454.

Fungi associated with the decomposition of leaf litters of *Albizia falcataria* and teak in Kerala were studied using the dilution plate method. Teak litter had Aspergillus, Penicillium, Coniella and Tritirachium sp. as the dominant early colonizers. The secondary colonizers of both the litters included several genera of fungi imperfecti and sterile forms. Members of the Mucorales and basidiomycete mycelium were predominant on highly decomposed litter. Fungi imperfecti were the dominant colonizers of the litters.

0455 Sankaran, K.V. 1997. **Decomposition of teak leaf litter**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 242-246. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

The rate of decomposition of teak litter was studied using the litter-bag method. The dry weight loss of the litter was 95.7 percent at the end of the study period. The decomposition rate was higher during the south-west monsoon than in the north-east monsoon. Loss in litter weight was positively correlated with moisture content of litter and rainfall. The time required for 95 percent weight loss of teak litter were estimated to be 18 months. It is found that the decay rate of teak leaf litter is faster than that of eucalypt and *Paraserianthes*. Litter moisture content is crucial for the decomposition under tropical warm-humid climate and the south-west monsoon provides congenial conditions for the rapid breakdown of leaf litters in Kerala.

0456 Saravanan, S; Buvaneswaran, C. 2003. **Litter dynamics in relation to stand density in teak (*Tectona grandis*) plantations**. Advances in Plant Sciences 16(1): 229-233.

A study was conducted on teak plantations in Mettupalayam, Tamil Nadu raised in five different spacings: S1- 1 x 1; S2- 2 x 1; S3- 1.5 x 1.5; S4- 2 x 1.5; and S5- 2 x 2 m, to investigate the influence of stand density on litter dynamics. It was found that the annual litter production varied significantly with density of the tree stands. The highest amount of litter was produced under the stand under S1 spacing of 530 kg/ha/year and the least amount of litter production of 260 kg/ha/year was recorded under S5. The tree stands under S1 and S2 spacing showed significantly slower rate of decomposition than the rest of the stands.

0457 Seth, S.K; Yadav, J.S.P. 1959. **Teak soils**. Indian Forester 85(1): 2-16.

Reviews the literature on teak forest soils, for both natural and artificial forests, with reference to India, Pakistan, Burma, and Indonesia, indicating the optimum conditions of soil, elevation, topography, moisture, nutrients etc. for teak growth and the relationship between geological formations and the composition and distribution of teak forests, teak's requirements as regards pH and lime, and soil deterioration under pure teak plantations.

0458 Shanmughavel, P; Francis, K. 1998. **Litter production and nutrient return in teak plantation**. Van Vigyan 36(2/4): 128-133.

Data are reported on litter production and nutrient return from a 9-yr-old pure teak plantation in Erode District, Tamil Nadu. Leaf litter made up 76-92 percent of the total litter. Nutrient contents of the leaves, twigs and reproductive parts were in the order Ca K N Mg P, whereas in the bark the order was Ca N Mg K P. Nutrient returns from litter in kg/ha were N 136.94, P 1.64, K 114.86, Ca 215.68 and Mg 118.32.

0459 Sharma, S.C; Pande, P.K. 1989. **Patterns of litter nutrient concentration in some plantation ecosystems**. Forest Ecology and Management 29(3): 151-163.

Patterns of litter nutrient concentration were studied in plantations of sal, teak, pine and eucalypts at Dehra Dun, India. Concentration of Ca and N were greater than K, Mg and P in all fractions of litter irrespective of species. Variation in concentration of leaf-litter nutrients is not a species' attribute but depends upon the combined effect of soil nutrient status, growth of the stand and tree growth formations.

0460 Singh, A.K; Ambasht, R.S. 1980. **Production and decomposition rate of litter in a teak (*Tectona grandis*) plantation at Varanasi**. Revue d'Ecologie et de Biologie du Sol 17(1): 13-22.

Leaf and non-leaf litter fall in a teak plantation in Varanasi forest division, India, were measured during a 12 month period. Maximum leaf litter fall occurred in February (65.7 gm-2) and non-leaf litter in March (9.8 gm-2). The maximum monthly decomposition (11.25 g), CO_2 evolution (114.97 mg CO2 m-1 hr-1) and moisture content (51.21) of litter occurred in September. 90.68 of the total litter was decomposed in the year of its production.

0461 Singh, M. 1997. **Effect of nitrogen, phosphorus, potassium and soil working on the growth of teak plants**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 43-45. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Sites in clear-felled, first rotation teak plantation were selected and experiments on the effect of different levels of nutrients and soil working on growth of 6 months old teak plants were carried out. Urea, Rock Phosphate, and muriate of Potash were applied at 3 levels. Soil working at 30, 45, and 60 cm radius around the plants was done. Due to the addition of nutrients, more than 60 per cent increase in height of plants over control was observed. Maximum increment recorded over control was 78.4 cm. NPK at the dose of 30g N+6g P+3G K was found to be the optimum. Soil working also resulted into a height increment of more than 80 percent over control.

0462 Singh, O; Sharma, D.C; Rawat, J.K. 1993. **Production and decomposition of leaf litter in sal, teak, Eucalyptus and poplar forests in Uttar Pradesh**. Indian Forester 119(2): 112-121.

Leaf litter plots (10X10 m) were laid out in November 1990 in a 90-yr-old natural sal (*Shorea robusta*) forest and in plantations of teak (*Tectona grandis*, 15 yr old) *Eucalyptus hybrid* [*E. tereticornis*] (6 yr old) and poplar (*Populus deltoides*, ONDA clones, 4 yr old) at Ram Nagar in NW Uttar Pradesh. Litter collections were made quarterly from 3 plots per stand. Decomposition and nutrient studies were also undertaken: (1) using the nylon bag technique - 16 bags were placed on the forest floor in each stand, and 4 bags sampled quarterly from each; and (2) by analysing forest floor samples consisting of fresh, partially or completely decomposed leaf material collected from 50X50 m quadrats in each stand. Maximum litterfall in sal was in mid-February to mid-May, in teak in mid-November to mid-February and in poplar in the winter; leaf shedding was more or less continuous in *E. tereticornis*. Annual amounts of leaf litterfall were 6.86, 7.70, 6.51 and 5.29 t/ha (dry weight) in sal, teak, *E. tereticornis* and poplar, respectively. Decomposition rate (K) was highest in sal (2.01), followed by teak (1.26), poplar (1.05) and *E. tereticornis* (0.69); these rates were slightly higher than those calculated on the basis of forest floor accumulations. Time required to reach steady state accumulation was also calculated. The mineralization of the major nutrients (N, P, K, Ca, Mg) in each stand is discussed.

0463 Sinha, A; Pathak, S.K. 1995. **Relationship between microbial population and carbon dioxide evolution from decomposing leaf litter of teak (*Tectona grandis* Linn.f.)**. New Agriculturist 6(2): 129-133.

Leaf litter of *Tectona grandis* was collected from the Chandraprabha Sanctuary of Varanasi forest division and its decomposition was studied by keeping the litter in nylon net bags. Population densities of fungi, actinomycetes and bacteria and CO2 evolution from decomposing litter were estimated monthly. In August the highest build up of fungal (82.72 X 104/g of dry litter), actinomycetous (37.04 X 106/g of dry litter) and bacterial (166.67 X 104/g of dry litter) populations coincided with the period of maximum CO2 evolution (119.96 ± 4.82 mg CO2/m2/h). CO2 evolution from decomposing litter was highly correlated with (1) fungal population (r = + 0.8584 P 0.001), (2) actinomycetous population (r .

0464 Sujatha, M.P; Jose, A.I; Sankar, S. 2003. **Leaf litter decomposition and nutrient release in reed bamboo (*Ochlandra travancorica*)**. Journal of Bamboo and Rattan 2(1): 65-78.

Results of a study conducted on the *in situ* reed (*Ochlandra travancorica*) leaf litter decomposition at two selected sites: a pure reed patch and a teak plantation with reed undergrowth in Vazhachal, Kerala are presented.

0465 Suwannaratana, S. 1999. **Comparison of teak and pine plantations in northern Thailand. Thesis: 135p**. Universitat des Saarlandes, Saarbrucken, Germany.

Chemical and physical characteristics of soil, ground flora, nutrient cycling and litter decomposition were compared for sample sites in natural teak forest, teak plantations, a degraded teak forest in Ngao district, Lampang and pine plantations in Hot District, Chiang Mai, both sites in northern Thailand. Measurements were made of soil organic carbon, pH, cation exchange capacity and nutrients. The highest organic C content was recorded in the natural *T. grandis* forest and the lowest level was in the 50-year-old *T. grandis* plantation. The net primary production of the ground flora was highest in the degraded teak forest area. Species diversity index of ground flora was highest in the natural teak forest. In terms of ground flora and soil properties, the teak plantations represented a greater ecological benefit to the area than the pine plantations, and with increasing age, plantation ground flora communities become more similar to that of the natural forest.

0466 Swamy, H.R; Proctor, J. 1997. **Fine litterfall and its nutrients in plantations of *Acacia auriculiformis*, *Eucalyptus tereticornis* and *Tectona grandis* in the Chikmagalur District of the Western Ghats, India**. Journal of Tropical Forest Science 10(1): 73-85.

A study was made of the soil properties and litterfall in plantations of *Acacia auriculiformis* , *Eucalyptus tereticornis* and *Tectona grandis* in Karnataka, India. All the sites had nutrient-rich soils and occurred under a highly seasonal climate with mean annual rainfall of 2003 mm (Tectona). The mean annual total fine litterfall was Tectona 11.4 t ha-1. The litterfall was seasonal with the highest peaks in the dry season in the case of teak and eucalypts.

0467 Tamboli, R.A; Vagyani, B.A. 2001. **On the occurrence of fossil *Tectona* leaf from Aundh, district - Satara, Maharashtra**. Advances in Plant Sciences 14(1): 209-210.

The paper gives an account of fossil leaf impression found in the calcareous tufaceous deposit found near Aundh in Satara district of Maharashtra. The locality belongs to Sub-Recent-Late Plaeistocene period. Several leaf impressions are exposed. A specimen closely agrees with the characters of *Tectona grandis* is described.

0468 Thaiutsa, B; Suwannapinunt, W; Kaitpraneet, W. 1978. **Preliminary study of production and chemical composition of forest litter in Thailand**. Forest Research Bulletin 52: 32p. Kasetsart University, Bangkok.

Data are presented from teak, bamboo, dry dipterocarp and hill evergreen forests, and from a 12-yr-old pine plantation in central and northern Thailand. Nitrogen content was highest in litter from dry dipterocarp forest and lowest in that from hill evergreen forest. Nitrogen and potassium contents of litter were lower at higher altitudes.

0469 Vyas, L.N; Garg, R.K. 1976. **Litter production and nutrient release in deciduous forest of Bansi, Udaipur, India**. Flora German Democratic Republic 165(2): 103-111.

Tabulates the litter fall, nutrient content of the litter and estimated release of nutrients from the litter to the soil for fourteen tree species in dry deciduous forest dominated by *Tectona grandis*. Estimated annual nutrient release varied from 78.42 kg/ha for Ca to 3.92 kg/ha for Na, decreasing in the order Ca, N, K, Mg, P, Na. Observations suggest that leaves of *T. grandis* release the greatest amounts of Ca, N, Na and K.

0470 Xue, L; Chen, H.Y; Bi, H.Y; Tan, S.M. 2002. **Soil nutrient, microorganism and enzyme activity in pure stands of Acacia mangium and *Tectona grandis***. (Chinese). Journal of South China Agricultural University 23(2): p93.

Go top

Soil Microorganisms

(See also 0429, 0448, 0454, 1588)

0471 Amakiri, M.A. 1977. **Effect of herbicides on microbial populations and activities in soils under teak (*Tectona grandis* Linn.f.) plantation**. East African Agricultural and Forestry Journal 42(4): 420-426.

Soil samples taken from a teak plantation in Nigeria were moistened to field capacity with one of three herbicides of chloroxuron, metabromuron, fluometuron at 0.25, 0.5, 1.0 or 2.0 p.p.m. The total numbers of bacteria and of Nitrosomonas and Nitrobacter were assessed and NO3-N, NO2-N and NH4-N were analysed. Both stimulatory and inhibitory effects on the microbial population were observed, depending on the herbicide, its concentration and the period of incubation. Nitrosomonas was more sensitive to the herbicides than Nitrobacter.

0472 Askary, T.H; Ali, M.S; Haider, M.G. 2000. **Occurrence of plant parasitic nematodes on forest plantations in North Bihar**. Journal of Research, Birsa Agricultural University 12(2): 263-264.

A survey was conducted in the Pusa region in North Bihar to determine the types and densities of nematodes associated with forest plantations. Pratylenchus, Meloidogyne, Hoplolaimus, Rotylenchulus and Paratylenchus were found in varying populations infesting different forest plants. Total nematode population varied from 145 to 1460 per 500 g soil, the highest population was around *Tectona grandis*. Teak had the highest population of Tylenchorenchus, Helicotylenchus, Meloidogyne and Rotylenchus.

0473 Badejo, M.A; Ola-Adams, B.A; Sharma, K. 2000. **Abundance and diversity of soil mites of fragmented habitats in a biosphere reserve in southern Nigeria**. Pesquisa Agropecuaria Brasileira 35(11): 2121-2128.

Soil samples were collected from the top 7.5 cm of soil in a Strict Natural Reserve, a surrounding buffer zone, a cassava farm and matured plantations of Gmelina, teak and pine to determine if plantation establishment and intensive cultivation affect the density and diversity of soil mites. A total of 41 taxonomic groups of mites were identified. Teak was dominated by predatory mesostigmatid .

0474 Basu, S; Pati, D.P; Behera, N. 1992. **Microfungal biomass in some tropical forest soils of Orissa, India**. Forest Ecology and Management 55(1/4): 333-339.

An investigation was carried out to estimate microfungal biomass and its relation to soil organic matter content in nine different tropical broadleaved forest soils from Orissa. Dominant tree species were *Tectona grandis* and *Shorea robusta*. There was a significant positive relation between microfungal biomass and soil organic carbon concentration.

0475 Bhadraiah, B; Kanakadurga, V.N; Ramarao, P; Manoharachary, C. 2002. **Effect of AM fungi and rock phosphate on phosphatase activities in *Tectona grandis* Linn.f.** Frontiers in microbial biotechnology and plant pathology: 259-262. C. Manoharachary; D.K. Purohit; S.R. Reddy; M.A.S. Charya; S. Girisham, Eds. Scientific Publishers, Jodhpur.

Seedlings of *T. grandis* grown in polythene bags in sterilized soil were treated with *Glomus mosseae, G. fasciculatum* and rock phosphate (P) separately and also in various combinations. The root and shoot tissues of treated plants were analysed for the acid and alkaline phosphatases. Acid phosphatase activity greatly increased in Gm+Gf+P-treated roots followed by Gf and Gf-treated roots, while in shoots, the activity was maximum in P-treated plants followed by Gf+Gm+P- and Gm+Gf-treated plants.

0476 Chandra, K.K; Jamaluddin. 1999. **Dynamics of VAM infectivity and their population under different seasons in teak and bamboo plantations of Chandrapur (M.S.)**. Vaniki Sandesh 23(1): 16-20.

Seasonal variations in rhizosphere vesicular arbuscular mycorrhizal (VAM) spores and in root VAM infection were studied in a teak seed production area in Maharashtra. The mycorrhizal fungi present were *Glomus* spp., *Acaulospora scrobiculata*, Gigaspora, Scutellospora and Sclerocystis; *Glomus* spp. were the most common. In teak the maximum number of rhizosphere VAM spores were found in the summer and the least in spring and winter.

0477 Chandra, K.K; Ujjaini, M.M. 2002. **Interaction of A M F with three levels of soil organic matter and their influence on seedling biomass and root infection of six forest species**. Myforest 38(2): 155-161.

Mycorrhizal fungi were inoculated with three levels of soil organic matter in species including *Tectona grandis* seedlings. Addition of organic matter in soil was found to enhance the plant biomass. But it decrease the responsiveness to mcycorrhizal fungi. Mycorrhizal infection was increased in non-inoculated plants, while decreased in inoculated plants with increasing level of organic matter in soil.

0478 Chong, L. 1988. **Occurrence of mycorrhizae in seedlings of some tree species in Sarawak**. Mycorrhiza for Green Asia. Proceedings of the 1st Asian Conference on Mycorrhizae, Madras, 29-31 January 1988: 70-72. A. Mahadevan; N. Raman; K. Natarajan, Eds.

Roots of twenty five species of seedlings from the Oya Road nursery and twelve species from the Niah Research Station nursery were examined for mycorrhizal infection. Endomycorrhizal fungi were observed in twenty five species including *Tectona grandis* seedlings having little effect on root morphology.

0479 Coster, C. 1921. **Mycorrhiza in some of our trees, particularly that of teak**. (Indonesian; English). Tectona 14: 563-575.

0480 Dadwal, V.S; Soni, K.K; Jamaluddin. 1986. **Rhizosphere microflora of teak (*Tectona grandis*)**. Indian Journal of Forestry 9(1): 59-62.

Soil samples were collected from around the roots of plants aged 3-6 months, 2 or 10 yr, grown in Madhya Pradesh. Fungi were cultured and identified and results tabulated. The greatest number of species were cultured from rhizosphere samples from 3- to 6-month-old seedlings.

0481 Das, P.K; Nath, S; Banerjee, S.K. 1991. **Distribution of microorganisms in soils under different forest cover at different altitudes**. Indian Agriculturist 35(4): 217-223.

The distribution of bacteria, actinomycetes and fungi was studied in the litter layer and mineral soil layer under different vegetative cover including teak at different altitudes in the Himalayan region of West Bengal. In the lower hill region under *T. grandis* and *S. robusta* the surface soil layer had a higher number of bacteria, actinomycetes and fungi than the subsurface layers. The distributions and numbers of microorganisms in the soil horizons under different vegetation varied considerably. The highest numbers of bacteria and actinomycetes were found in the surface soil under *T. grandis*.

0482 Dhar, P.P; Mridha, M.A.U. 2003. **Status of colonisation and spore population of Arbuscular mycorrhial fungi in *Tectona grandis* Linn.f. from Bangladesh**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

The status of colonization of Arbuscular Mycorrhizal (AM) fungi in the roots and spore population in the rhizosphere soils of teak were assessed. Roots and rhizosphere soils of teak plants both from nursery and plantations were collected from different areas of Bangladesh. Biodiversity of structural colonization in the roots and AM fungal spore population in the rhizosphere soils of teak growing areas highlights the dependency of teak on arbuscular mycorrhizal fungi.

0483 Durga, V.V.K; Gupta, S. 1995. **Effect of vesicular arbuscular mycorrhizae on the growth and mineral nutrition of teak (*Tectona grandis* Linn.f.)**. Indian Forester 121(6): 518-527.

The effect was studied of the VAM fungi *Glomus fasciculatum* and *Glomus mosseae* ± rock phosphate on initial establishment and mineral nutrition of 3 month old teak stumps in polybags. Measurements were made of the uptake of various macronutrients of N, P, K and micronutrients of Cu, Zn, Fe, Mn, and of various growth parameters. *G. mosseae* + *G. fasciculatum* treated plants had greater growth and also showed an increase in concentrations of phosphate, K and Mn, while N, Cu, Zn, Fe concentrations decreased in the shoots. The possible role of VAM in the growth of teak is discussed.

0484 Faiqoh, M.N; Nor Aini, A.S; Azizah, H; Halimi, M.S. 2001. **Physiological changes of *Tectona grandis* Linn.f. and *Gmelina arborea* Roxb. through arbuscular mycorrhizal symbiosis**. Tropical forestry research in the new millennium: Meeting demands and challenges. Proceedings of the International Conference on Forestry and Forest Products Research, 1-3 October 2001, Kuala Lumpur: 545-546. Forest Research Institute Malaysia, Kuala Lumpur, Malaysia.

0485 Gong, M.Q; Wang, F.Z; Chen, Y; Liang, K.N. 2002. **Research on mycorrhiza of *Tectona grandis* and its effect on seedling growth**. Forest Research 15(5): 515-520.

An investigation of sites in three provinces of South China show that all the root samples of teak were infected by arbuscular mycorrhizal fungi in the natural condition. Teak seedlings inoculated artificially by AMF and the infection rate was compared with the infection in natural condition. It is found that the height, ground diameter and biomass of inoculated seedlings increased compared with the control seedlings.

0486 Gurumurthy, S.B; Sreenivasa, M.N. 1998. **Screening and selection of efficient VA mycorrhizal fungus for teak (*Tectona grandis* Linn.f.)**. Karnataka Journal of Agricultural Sciences 11(4): 956-960.

An investigation was carried out to select an efficient VAM fungus that improves growth, nutrition and dry matter production of teak in unsterile soil. Per cent root colonization, mycorrhizal spore counts, population of free living N2-fixers and P-solubilizers were significantly higher in the rhizosphere of teak plants inoculated with *Sclerocystis dussii* as compared with the other VAM fungi tested. An increase in plant height, stem diameter, leaf area, root length, shoot dry weight, root dry weight and the concentrations of P, Zn, Cu, Mn and Fe is noted in shoots which also greatest in plants inoculated with *S. dussii*.

0487 Gurumurthy, S.B; Sreenivasa, M.N. 2000. **Occurrence and distribution of VAM fungi in the rhizosphere of five tree species grown under agroforestry system**. Environment and Ecology 18(2): 500-502.

A survey was conducted to isolate the predominant native VAM fungi in northern Karnataka in the rhizosphere of five tree species, namely, teak, silver oak, casuarina, shisham and tamarind. Two predominant VAM spore types were observed in the rhizosphere soils of teak and silver oak.

0488 Hossain, S.M.Z; Anwar, M.N. 1996. **Isolation of cellulolytic microorganisms from forest and garbage soil and screening for cellulase activity. I. The cellulolytic bacteria**. Bangladesh Journal of Botany 25(1): 19-24.

The isolation and study of cellulolytic microorganisms from the soil under a *Tectona grandis* forest plantation with many other plantations and a garbage centre located in Chittagong, Bangladesh is described. Seventy-one bacterial colonies are detected using Czapek's medium. Five selected bacterial strains are studied in detail for cellulase activity, saccharification, biomass production and their identification is also attempted.

0489 Hossain, S.M.Z; Anwar, M.N. 1996. **Isolation of cellulolytic microorganisms from forest and garbage soil and screening for cellulase activity II: The cellulolytic fungi**. Chittagong University Studies, Science 20(1): 83-88.

An attempt was made to isolate and study the cellulolytic microorganisms from the soil under *Tectona grandis* plantations along with many other plantations and a garbage centre located at Anandabazar in Chittagong, Bangladesh. 35 fungal colonies were detected. Of these, 3 fungal strains were selected and studied in detail for cellulase, saccharification and biomass production, Their identification was also attempted.

0490 Jamaluddin; Chandra, K.K. 1997 . **Distribution of VAM fungi in bauxite mine overburden plantation of Amarkantak (Madhya Pradesh)**. Indian Forester 123(5): 412-418.

A study was made of VAM fungi in the soil, tree root colonization and tree growth in plantations of 11 species including teak. Measurements of tree growth and soil VAM fungi and colonization were made in plantations of the same tree species in a nearby degraded forest area, and of VAM fungi in adjacent barren bauxite overburden. The forest plantations enhanced the VAM population.

0491 Johnston, A. 1949. **Vesicular arbuscular mycorrhiza in Sea Island Cotton and other tropical plants**. Tropical Agriculture, Trinidad 26(7/12): 118-121.

Many species including teak were found to be infected in varying degrees by Vesicular-arbuscular mycorrhizae. Two types of endophyte were recognized, differing in the mode of degeneration of the fungus in root cells. These are termed the `sporangiolar' and `intracellular hyphal'.

0492 Kalshoven, L.G.E. 1941. **Influence of local microscopic fauna, in particular termites, on the fertility of soil**. (Dutch; English). Tectona 34: 568-582. Agricultural University, Wageningen.

0493 Kama, M; Singh, C.S. 1970. **Studies on soil fungi from teak forests of Gorakhpur. VIII. A comparison of fungi of earthworm casts, termitarium and surrounding soil from a teak stand**. Annales de l' Institut Pasteur, Paris 119(2): 249-259.

The fungus population was rich in the surrounding soil. Earthworm casts, which were rich in nutrients, contained fewer fungi imperfecti such as *Aspergillus* and *Penicillium* spp. Phycomycetes were most abundant in the surrounding soil and least in the termitaria, which consisted mainly of wood particles.

0494 Kamal; Bhargava, K.S. 1973. Studies on soil fungi from teak forests of Gorakhpur. X. Edaphic factors and distribution of soil microfungi in teak stands of different ages. Proceedings of the National Academy of Sciences, India B 43(1/2): 9-16.

0495 Kosol, S; Manoch, L; Tangtham, N; Boonyawat, S; Oates, C.G. 1999. **Biodiversity of micro fungi in soil, water and plant under teak plantation of Linthin Watershed Kanchanaburi Province**. (Thai). The 37th Kasetsart University Annual Conference, 3-5

February 1999: 211-216. Text and Journal Publication, Bangkok.

The microfungi isolated from teak plantations were of 11 species of Ascomycete, 4 Coelomycetes, 99 Hyphomycetes, 5 Zygomycetes, 25 unidentified species and 20 species of sterile hyphae.

0496 Manna, M.C; Jha, S; Ghosh, P.K; Acharya, C.L. 2003. **Comparative efficacy of three epigeic earthworms under different deciduous forest litters decomposition**. Bioresource Technology 88(3): 197-206.

Examined the influence of certain tropical epigeic earthworms on the decomposition processes of forest litters including teak. The results indicated that teak litter was the most suitable food material for the earthworms because of high reserves of mineral nutrients in teak.

0497 Mohanan, C. 2003. **Mycorrhizae in forest plantations: Association, diversity and exploitation in planting stock improvement**. KFRI Research Report 252: 133p. Kerala Forest Research Institute, Peechi.

A survey on mycorrhizal association in forestry species raised in plantations/plots and natural stands in different parts of the State was made and their mycorrhizal status and mycorrhizal dependency were studied. *Tectona grandis* was one of the species studied. Teak exhibited a high level of AM fungal association in most of the 70 plantations surveyed. Laboratory and nursery trials were carried out to improve the planting stock of selected tree species including teak using arbuscular mycorrhizal fungi. Seedling height as well as total biomass are reported increased in AM fungal treated seedlings.

0498 Mohanan, C; Sheeba, K.K. 2003. **Productivity of teak stands in Kerala: Role of arbuscular mycorrhizal association and diversity of AM fungi**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

A survey on mycorrhizal association in teak plantations in different parts of Kerala state was made. The root infection as well as AM fungal species association varied with age of the plants and soil physical and chemical properties. Soil pH, soil moisture contents and soil nutrient status were found influencing the AM fungal root colonization and distribution of spores in rhizosphere soil.

0499 Moureaux, C. 1972. **Microbiology as a factor in the solubilization of minerals derived from a ferralitic soil in Madagascar and from biotite in the presence of tropical litter (*Tectona grandis* and *Melaleuca leucadendron*).** Revue d'Ecologie et de Biologie du Sol 9(3): 539-547.

The microbiological solubilization of Fe, Al, Ca, Mg, K and SiO_2 was studied by comparison with sterile replicas from a ferralitic soil in Madagascar and from biotite. The microbiological action was marked in the case of Fe, especially with *T. grandis* litter.

0500 Naha, S.K; Rahman, M.S; Anwar, M.N. 1998. **Cellulolytic microorganisms of soil under deciduous and evergreen forest at Chittagong University Campus**. Bangladesh Journal of Forest Science 27(1): 42-48.

Microorganisms were isolated from the soil under two deciduous including *Tectona grandis* and two evergreen forest plantations in Bangladesh. The relationships of these organisms to soil properties was investigated. Maximum cellulolytic activity of fungi and actinomycetes was recorded in teak soil. Soil moisture and pH were highest under *T. grandis*.

0501 Naik, S.T; Devar, K.V; Suryanarayana, V; Raichur, R.G. 2001. **Seed mycroflora of some important tree species**. Indian Journal of Forestry 24(1): 8-11.

Data are presented on the microbial flora associated with the seeds of different forest tree species including teak studied using the Blotter test and Agar plate technique.

0502 Odu, C.T.I; Adeoye, K.B. 1970. **Heterotrophic nitrification in soils-a preliminary investigation**. Soil Biology and Biochemistry 2(1): 41-45.

Fungi and bacteria isolated from soil samples from soil in a 16-year teak plantation in Nigeria were found capable of producing nitrite and nitrate, or both, in a glucose/peptone medium, soil organic matter extract or sterilized soils. The ecological importance of heterotrophic nitrification is briefly considered.

0503 Okoegwale, E.E. 1983. **The influence of *Tectona grandis*, *Gmelina arborea*, temperature and moisture on microbial population dis-**

tribution. Thesis Summary. Forestry Abstracts 44(10): p608.

0504 Paroha, S; Chandra, K.K; Tiwari, K.P. 2000. **Synergistic role of VAM and Azotobacter inoculation on growth and biomass production in forestry species**. Journal of Tropical Forestry 16(1): 13-21.

One month old seedlings of *Tectona grandis* along with other species in the nursery were inoculated with VAM and with culture of *Azotobacter chroococcum*. The inoculated seedlings exhibited improved growth and biomass. Root development was maximum either with VAM or with VAM + Azotobacter. By mycorrhization, biomass of *T. grandis* doubled.

0505 Parthiban, K.T; Rai, R.S.V. 1993. **Effect of some tree species on rhizosphere microflora**. Advances in Forestry Research in India 8: 91-105.

Reports the rhizosphere microflora around seven species including teak raised as woodlots at Coimbatore, Tamil Nadu.

0506 Rahman, M.F; Jairajpuri, M.S; Ahmad, W; Ahmad, I. 1986. ***Amphibelondira* gen. n. (Nematoda: Belondiroidea) from Bhutan**. Indian Journal of Nematology 16(2): 149-151.

Amphibelondira bhutanensis n.g., n.sp. collected from around the roots of teak in Bhutan is described with illustrations.

0507 Rahman, M.S; Khan, N; Mridha, M.A.U; Hossain, M.K. 2000. **Arbuscular mycorrhizal colonization in teak (*Tectona grandis* Linn.f.) seedlings grown from pre-sowing treated seeds**. Journal of Science 24(2): 33-38.

0508 Rajan, S.K; Reddy, B.J.D; Bagyaraj, D.J. 2000. **Screening of arbuscular mycorrhizal fungi for their symbiotic efficiency with *Tectona grandis***. Forest Ecology and Management 126(2): 91-95.

A study was conducted under nursery conditions to study the efficacy of nine arbuscular mycorrhizal fungi on *Tectona grandis*. Teak seedlings raised in the presence of AM fungi generally showed an increase in plant growth and plant nutritional status over those grown with no soil inoculation of AM fungi. The extent of growth and nutritional status enhanced by the AM fungi varied with the species of fungus.

0509 Raman, N; Nagarajan, N; Sambanandan, K; Gopinathan, S. 1997. **Vesicular arbuscular mycorrhizal association with teak plantations in Yercaud Hills, Tamil Nadu, India**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 247-250. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Vesicular arbuscular mycorrhizal (VAM) association in teak trees and the physio-chemical characteristics of the rhizosphere soil in Tamil Nadu were studied Eight species of *Glomus*, two *Gigaspora* and one species of *Sclerocystis* were encountered in the rhizosphere soil.

0510 Ramanwong, K; Sangwanit, U. 2000. **Effect of vesicular arbuscular mycorrhizal fungi on the growth of teak seedlings**. Bio technology applications for reforestation and biodiversity conservation. Proceedings of the 8th International Workshop of BIO REFOR, Kathmandu, Nepal, 28 November-2 December 1999: 119-122. M.S. Bista; R.B. Joshi; S.M. Amatya; A.V. Parajuli; M.K. Adhikari; H.K. Saiju; R. Thakur; K. Suzuki; K. Ishii, Eds. BIO REFOR, Ministry of Forests and Soil Conservation, Kathmandu, Nepal.

Teak seedlings produced by a tissue culture technique were inoculated with the six species of vesicular-arbuscular mycorrhizal (VAM) fungi, *Acaulospora scrobiculata, Glomus aggregatum, G. deserticola, G. multicaulis, Sclerocystis microcarpus* and an unidentified species. The inoculated teak seedlings showed greater height, diameter at root collar, shoot dry weight, root dry weight and total dry weight than the control seedlings.

0511 Saksena, S.B. 1955. **Ecological factors governing the distribution of soil micro-fungi in some forest soils of Sagar**. Journal of Indian Botanical Society 34: 262-298.

An ecological study of the micro-fungi occurring in various types of forest soils-containing teak mixed with other species is conducted and the results are presented.

0512 Shetye, P.K. 1954. **Soil fungi from *Tectona* and *Diospyros* forests**. Bulletin Bot. Soc. Univ. Saugar 6(1/2): 20-23.

Soil fungi were studied on sites where either *T. grandis* or *D. melanoxylon* was dominant. The author isolated 27 spp. belonging to 12 genera, of which 5 spp. are new records for India.

0513 Sugavanam, V; Udaiyan, K; Devraj, P. 1998. **Selection of an efficient vesicular arbuscular mycorrhizal fungi and *Azospirillum* sp. for inoculating *Tectona grandis*.** Indian Journal of Forestry 21(4): 281-284.

The influence of six vesicular-arbuscular mycorrhizal fungi on the growth of seedlings of *Tectona grandis* was tested. Inoculation with individual VAM fungi or *Azospirillum* sp. increased growth, biomass production, root colonization, and tissue N, P and K concentrations and reduced root shoot ratio.

0514 Talukdar, N.C; Thakuria, D. 2001. **Diversity and importance of vesicular arbuscular mycorrhizal fungi in teak (*Tectona grandis*) and gomar (*Gmelina arborea*) plantations of Assam. Tropical Forestry Research: Challenges in the New Millennium.** Proceedings of the International Symposium, Peechi, India, 2-4 August 2000. R.V. Varma; K.V. Bhat; E.M. Muralidharan; J.K. Sharma, Eds: 177-182. Kerala Forest Research Institute, Peechi.

Soils and root samples collected from teak and gomar plantations at 18 locations under 11 reserve forests of Assam were analysed for spore numbers, levels of vesicular arbuscular mycorrhizal fungi colonization and VAMF species. Effect of two common VAMF on teak and gomar stumps was investigated.

0515 Thapa, R; Ganguly, S. 1990. **Association of *Paralongidorus sali* Siddiqi *et al*., a dorylaimid phytonematode, and other nematodes with sal and teak in Dehra Dun District, Uttar Pradesh**. Indian Journal of Forestry 13(1): p65.

A survey carried out indicated the widespread occurrence of the needle nematode *Paralongidorus sali* in sal forests all over Dehra Dun District and in teak plants at New Forest. Populations were higher in sal than in teak. The nematode occurred in seedlings and older trees. Other plant parasitic nematodes found in the soil samples collected included *Xiphinema americanum, Macroposthonia xenoplax, Hemicriconemoides cocophillus* and *Tylenchorhynchus indicus*.

0516 Thapa, R; Ganguly, S. 1993. **Phytoparasitic nematodes associated with some forest plants around Dehra Dun, Uttar Pradesh, India**. Annals of Plant Protection Sciences 1(2): 129-131.

Soil samples were taken from the rhizosphere of seedlings and mature forest plants from around Dehra Dun, Uttar Pradesh and analysed and it is found that *Xiphinema insigne* were predominant on *Tectona grandis*.

0517 Verma, R.K; Jamaluddin. 1995. **Association and activity of arbuscular mycorrhizae of teak (*Tectona grandis*) in central India.** Indian Forester 121(6): 533-539.

Arbuscular mycorrhizal fungi of teak were isolated from 20 different sites in Madhya Pradesh, including nursery, plantation and natural forests, and studies made of the percentage root colonization in the rhizosphere samples, and of the effect of inoculation on teak seedling growth. Genetically superior trees showed heavier root colonization than other trees. Inoculation of seedlings with *G. fasciculatum* or mixed AM fungi showed better height growth, biomass and percentage root infection in the nursery.

0518 Verma, R.K; Kumar, P; Ansari, S.A. 2001. **Comparative physiomorphological performance of half-sib seedlings of ten teak clones under suboptimal and optimal arbuscular mycorrhizal colonisation**. Journal of Tropical Forest Science 13(3): 423-433.

The physiomorphological response of half-sib seedlings of ten teak clones to native and introduced arbuscular mycorrhizal fungi inocula was tested under nursery conditions. The AM fungi inoculum improved root colonisation in all clones, leaf P level, leaf number, stomatal conductance, transpiration rate, photosynthetic rate, water use efficiency, nitrate reductase activity, plant dry weight, seedling volume in certain clones.

0519 Vijaya, T; Srivasuki, K.P. 2001. **Growth enhancement of *Tectona grandis* inoculated with *Glomus macrocarpus* and *Aspergillus niger* and associated effects on microbial population and phosphatase activity in potting mixes.** Indian Journal of Forestry 24(3): 279-283.

The growth response of teak seedlings to inoculation with each of *Glomus macrocarpus* and *Aspergillus niger* and a combination of both was studied in three different organic substrates. The associated effects of inoculation on microbial population and phosphatase activity were also recorded.

0520 Vijaya, T; Srivasuki, K.P. 2001. **Response of micropropagated *Tectona grandis* to dual inoculation with *Glomus macrocarpus* and *Bacillus megatherium*.** Indian Journal of Forestry 24(1): 43-47.

A study was conducted to determine the response of micropropagated teak plantlets to dual inoculation with *Glomus macrocarpus* and *Bacillus megaterium*. The treatments increased the content of P, Ca, Mg, Na and K in micropropagated teak plants. Maximum amount of nutrients were found in the plants inoculated with dual inoculum of *G. macrocarpus* and *B. megaterium*.

Go top

Soil and Water Conservation

0521 Aguilar Molina, C.A. 1977. **Erosion in teak plantations (*Tectona grandis*)**. (Spanish). Sociedad de Ingenieros Agronomos de El Salvador 6(1): 2-4; 6-10.

0522 Baconguis, S.R. 1991. **Evaluation of *Leucaena leucocephala* de Wit, *Tectona grandis* Linn.f., *Pterocarpus indicus* Willd. and *Eucalyptus deglupta* Blume for stream bank stabilization in the Agusan River Basin**. Sylvatrop 1(1): 79-101.

Leucaena leucocephala, *Tectona grandis*, *Pterocarpus indicus* and *Eucalyptus deglupta* were evaluated for their adaptability and erosion control potential on the stream banks of Agusan river basin in the Philippines. The lower erosion rate in plots covered by *T. grandis* was attributed to the species' more developed canopy, thus providing more ground cover than the other two species in protecting the soil from the erosive impact of raindrops.

0523 Bandara, T.M.J; Somasiri, S. 1992. **Influence of land use on catchment runoff and its impact on the village tank water supply in the dry zone**. Tropical Agriculturist 148: 89-95.

The impact of different land use types, namely rainfed shifting cultivation, monoculture teak and forests, was studied on runoff generation. Runoff from teak forest was more than twice that of mixed forest. It is proposed that further evaluation of the usefulness of teak monoculture as a catchment protection measure against soil erosion is required.

0524 Bell, T.I.W. 1973. **Erosion in the Trinidad teak plantations**. Commonwealth Forestry Review 52(3): 223-233.

Teak has been planted in Trinidad for fifty nine years. As a result of repeated burning, most of the coppice and natural regeneration has been killed and soil erosion under the teak crop has caused concern for many years. It is recommended that an undergrowth of mixed species must be maintained and fires must be prevented if serious erosion is to be avoided. Planting of teak in strips of three rows separated by unplanted strips is recommended on a trial basis.

0525 Chunkao, K; Kurat, P; Boonyawat, S; Dhanmanonda, P; Panburana, N. 1976. **Soil and water losses of Mae Huad forests in Lampang**. (Thai). Kasetsart University, Kog Ma Watershed Research Bulletin 28: 51p.

Sediment yields and surface runoff were much greater in the teak plantation than in other cover types. Some data are presented on changes after burning and cutting undergrowth of girth less than 10 cm.

0526 Dabral, B.G; Rao, B.K.S. 1968. **Interception studies in Chir and teak plantations - New Forest**. Indian Forester 94(7): 541-551.

Stemflow, interception, and throughfall were measured in a plantation of *Pinus longifolia* and *Tectona grandis* at Dehra Dun. Mean throughfall and interception were 73.2 percent and 20.8 percent for teak. A direct relation existed between diameter and stemflow in pine, but no relation existed in teak.

0527 Elsenbeer, H; Newton, B.E; Dunne, T; Moraes J.M de. 1999. **Soil hydraulic conductivities of latosols under pasture, forest and teak in Rondonia, Brazil**. Hydrological Processes 13(9): 1417-1422.

The changes of saturated hydraulic conductivity with depth of latosols developed on Precambrian basement rocks under primary rain forest, pasture and teak plantations was investigated in Brazil.

0528 Fazlul Hoque, A.K.M; Hamid, A. 1978. **Soil erosion in teak plantations**. Proceedings of the First Bangladesh National Conference on Forestry, Dacca, 11-15 February 1977: 80-83.

0529 Groof, G De. 1944. **Soil conservation and agriculture policy in the Congo**. Bulletin of Agriculture Congo belge 35: 118-136.

Author reviews the damages of degradation and erosion of tropical rain forest soils. He considers planting of exotic species like eucalyptus, casuarine, teak and other species prepared for rapid growth have advantages due to their more exacting demands on nutrient elements in the soil and have to be planted.

0530 Haque, M.S; Osman, K.T. 1990. **Some aspects of practicing the clearfelling followed by artificial regeneration system in the Cox's Bazar forest division II. Soil erosion in Bangladesh**. Chittagong University Studies, Bangladesh, Science, Part 2, 14(1): 51-57p.

Soil erosion rate in 27-29 year old patch plantations of teak, gamar, jarul and their combinations and a newly clearfelled area of Ukhia Range in the Cox' Bazar Forest Division was evaluated in this study. Erosion intensity was in the order of teak-gamar mixture teak teak-gamar-jarul mixture gamar jarul. The average erosion rate under teak and jarul were 7.2 and 2.66 t/ha/year respectively. In the newly clearfelled area 256 and 102 t/ha soil losses in one year occurred in the gully and replanted areas respectively.

0531 Joeswopranjoto, S. 1957. **Soil conservation in teak plantations in Indonesia**. FAO Teak Sub-Commission, Bandung FAO/TSC-57/29: 5p. FAO, Rome.

The soil conservation problems in the teak forests of Indonesia are discussed. Study on surface run-off and erosion, and taungya system on soil conservation point of view are discussed. The soil conservation measures recommended in the teak forests areas are given and the future problem is highlighted.

0532 Kallarackal, J; Soman, C.K. 1998. **Tree water consumption - an ecophysiological analysis**. Water and nutrient management for sustainable production and quality of spices: Proceedings of the National Seminar, Madikeri, Karnataka, 5-6 October 1997: 141-152. A.K. Sadanandan; K.S. Krishnamurthy; K. Kandiannan; V.S. Korikanthimath, Eds. Indian Society for Spices, Calicut.

Several tree species are interplanted in plantations of spices, mostly for providing shade to herbaceous plants. Tree water use characteristics are important criteria in the management of irrigation in spice plantations. An ecophysiological investigation was undertaken of plantations of different species including *Tectona grandis*.

0533 Kerbert, H.J. 1908. **Is teak harmful?** Tectona 1: 301-304.

0534 Kushalappa, K.A. 1987. **Short note on trenching in teak plantation**. Myforest 23(1): 25-27.

A brief account is given of the Kanara Circle of Karnataka, where the teak plantations are on undulating and steep terrain, and soil erosion is high because of heavy grazing pressure and repeated fires which have led to a lack of natural regeneration and undergrowth. In order to conserve soil and moisture, trenches were dug 6 m apart in the plantations. Lime and mussoriphos were added to each trench to increase soil pH and phosphate status. The trenches had reduced runoff and soil loss for a short period.

0535 Mensbruge, G de la. 1961. **Soil conservation and forest rehabilitation in the savanna regions of the northern Ivory Coast**. (French). Centre Technique Forestier Tropical, Nogent-sur-Marne: 30p.

An account of experimental plantations of Cassia siamea, Tectona grandis, Gmelina arborea and Anacardium occidentale.

0536 Nema, A.G; Khare, A.K. 1992. **Effect of water logging on some forest plants**. Journal of Tropical Forestry 8(2): 187-188.

Root examination of the affected plants showed that damage was caused by asphyxiation. *Leucaena leucocephala*, *Melia azedarach*, *Moringa oleifera, Syzygium cumini* and *Tectona grandis* were found highly susceptible.

0537 Okali, D.U.U; Furtado, J.I. 1980. **Estimating water use by tropical forests: An example from a plantation teak forest**. Tropical ecology and development. Proceedings of the Vth International Symposium of Tropical Ecology: 581-591. International Society of Tropical Ecology, Kuala Lumpur, Malaya.

Gross precipitation, throughfall and stemflow were measured in a 25-yr-old plantation at Ibadan, Nigeria. Annual interception was 21 percent of the gross rainfall of 948 mm, and stemflow under 2 percent. The canopy storage capacity was 0.6 mm; the free throughfall coefficient was high. The calculation of transpiration and total water use by teak is discussed.

0538 Pandit, B.R; Chava, S.R.K; Rao, V.V.S.V. 1991. **Interrelationship of rainfall, throughfall and stemflow in teak forests**. Indian Journal of Forestry 14(4): 287-289.

Annual rainfall, throughfall and stemflow were studied in 7-yr-old teak stands in Dangs Forest near Pimpri and Waghal, Gujarat. Annual rainfall was 1998.9 mm at Pimpri and 1663.0 mm at Waghal. Throughfall at Pimpri and Waghal was 1059.2 mm and

946.6 mm respectively. Stemflow was 513.7 mm at Pimpri and 359.6 mm at Waghal. There was a significant correlation between throughfall and stemflow at both the study localities.

0539 Purwanto, I; Soerjono, R. 1989. **The effects of various soil conservation practices on soil erosion rates and surface runoff under a teak plantation at Bojonegoro**. (Indonesian). Buletin Penelitian Hutan 520: 19-30. Pusat Penelitian dan Pengembangan Hutan, Bogor.

Measurements were made of soil loss by erosion and of runoff in small erosion plots in a 43-yr-old teak plantation in East Java. Soil conservation practices tested were (a) horizontal ditches, (b) ground cover mulches and (c) a vegetative cover of Eupatorium. The most effective soil conservation treatment was c where annual soil loss was only 8.14 t/ha, followed by (b) and (a), with 18.18 and 31.85 t/ha loss respectively.

0540 Rajendrudu, G; Naidu, C.V. 1998. **Effects of water stress on leaf growth and photosynthetic and transpiration rates of *Tectona grandis*.** Biologia Plantarum 40(2): 229-234.

Three month old seedlings of teak grown after transplantation to fertile soil for 5-6 months at Tirupati were subjected to water stress by withholding watering continuously for 3 weeks. The growth rates of height and of length of developing leaves were decreased by about 50 percent during the second week and became negligible during the third week of water stress treatment. The rate of leaf production and internodal elongation were also decreased.

0541 Sabhasri, S. 1966. **Preliminary watershed management research in Northern Thailand**. Vanasarn 24(2): 178-183.

Describes the setting up of a National Committee to deal with catchment management and outlines the preliminary research now in progress. Hydrological studies are in progress in natural and plantation teak and small forested catchments, and on effects of burning etc.

0542 Tampubolon, A.P; Hamzah, Z. 1988. **Effect of water conservation measures on the growth of teak (*Tectona grandis*) seedlings in a low-rainfall zone**. (Indonesian). Buletin Penelitian Hutan, Pusat Penelitian dan Pengembangan Hutan 496: 1-15.

Teak was planted on a site marginally too dry for teak in Situbondo District, E. Java. Height increment over the next 6-11 months was significantly increased by a strip mulch 110 cm wide of black plastic or 60 cm wide of rocks, the plastic mulch being about twice as effective as the rock mulch.

0543 Tangtham, N. 1992. **Soil erosion problem in teak plantation**. Proceedings of the Seminar on 50 Anniversary of Huay-Tak Teak plantation, Bangkok, 5-8 August 1992.

Investigation on soil erosion in teak plantation was carried out. Three factors, ie., burn, fire control and undergrowth cutting were applied to determine their effects on surface runoff and soil erosion. In all conditions of driving force, surface runoff and soil erosion in teak plantation were the largest. Fire control decreased soil erosion in all forest types especially in teak plantation. Fire and steep slop including single canopy storey could be the factors causing such high erosion in teak plantation.

0544 Thomas, T.P; Sankar, S; Sujatha, M.P. 1997. **Quantification of soil and water loss from teak and eucalypt plantations**. KFRI Research Report 126: 35p. Kerala Forest Research Institute, Peechi.

Soil and water loss through surface run-off from a three year old teak plantation at Nilambur and a two year old eucalypt plantation at Thrissur have been quantified. Loss of water through run-off depended mainly on amount of rainfall and its distribution. Run-off water loss from the teak plantation on laterite soil with 8-12 slope was found to be 25-26 of the rainfall. The corresponding loss of soil was 4-15 metric tons per hectare.

0545 Yadav, A.K; Mishra, G.P. 1985. **Chemistry of stemflow and throughfall waters for some tropical dry deciduous forest trees II. Potassium, calcium and sodium**. Journal of Tropical Forestry 1(2): 99-111.

An increase in cation concentration was noted as rainfall passes through tree crowns. Significant variations due to species were observed in K and Ca concentration in stemflow and throughfall. Greater concentration of all three cations were recorded in stemflow than in throughfall. Maximum average concentration were recorded in stemflow and throughfall under *Tectona grandis*. Some significant positive correlations were found between cation concentration and pH and specific conductivity.

0546 Yadav, A.K; Mishra, G.P. 1985. **Chemistry of stemflow and throughfall waters for some tropical dry deciduous forest trees I. pH,**

specific conductivity, nitrogen and phosphorus. Journal of Tropical Forestry 1(1): 51-60.

Stemflow and throughfall samples were collected under 6 species including teak in Madhya Pradesh, central India. Stemflow samples had higher pH, conductivity and N concentration than throughfall and rainfall. There were significant differences among species in conductivity, N and P concentration in stemflow and in conductivity and P concentration in throughfall.

0547 Yadav, A.K; Mishra, G.P. 1985. **Distribution of precipitation under a tropical dry deciduous forest stand of central India**. Journal of Tropical Forestry 1(3): 182-197.

Incident precipitation, stemflow, throughfall and interception loss were recorded during the rainy seasons in mixed forest in Madhya Pradesh. Stemflow for individual trees ranged from 0 to 13 percent of incident precipitation, average stemflow was 6-7 percent of the total rainfall recorded. The amount of stemflow decreased as crown area and stem diameter increased. Average throughfall was 76-80 percent of incident rain, generally increasing as shower size increased. As a percentage of rainfall, interception loss decreased as rainfall increased.

0548 Yadav, J.S.P; Singh, K. 1976. **Effect of forest plantations on water stable aggregates of soil**. Journal of the Indian Society of Soil Science 24(4): 363-368.

Water-stable aggregates under teak, sal, *Pinus roxburghii* and *Acacia catechu* were studied in the Doon valley, Uttar Pradesh. The proportion of large water-stable aggregates was positively correlated with the organic matter content of the surface soil, while the proportion of small aggregates was positively correlated with subsoil clay content.

Go top

Plant Botany

0549 Bor, N.L. 1953. **Manual of Indian forest Botany**. Oxford University Press, London: 301-302.

Teak was dealt with.

0550 Bourdillon, H. 1895. **Forest trees of Travancore**. Forest Department of erstwhile Travancore State: p285.

Reports a tree in Achencoil valley, Travancore District measuring 26 ft. in girth but had a short bole. Also mentions a log of 7 ft. diameter at butt end and 2'6" diameter at a length of 70 ft. giving 900 cft. of timber, and extracted by British Naval Department.

0551 Bourdillon, T.F. 1908. **The forest trees of Travancore**. Travancore Government Press, Travancore: 280p.

0552 Brandis, D. 1907. **Indian trees**. Archibald Constable and Company Limited: 767p.

0553 Cordes, J.W.H. 1916. **Description of *Tectona grandis***. Tectona 9: 851-878.

0554 Coster, C. 1931. **Contributions to the botanical study of teak**. (Dutch; German). Tectona 24: 768-792.

0555 Fischer, C.E.C. 1923. **Descriptive list of the forest flora of the east central Madras**. Beekman, 1949.

0556 Foulkes, G.F. 1895. **Timber trees of South Kanara**.

0557 Gamble, J.S. 1956. **Flora of presidency of Madras**. Adlard and Son Limited, London: 764-765.

0558 Haines, H.H. 1926. **The botany of Bihar and Orissa**. Botanical Survey of India, Calcutta: 710p.

0559 Hooker, J.D. 1897. **Flora of British India 1892-97**. L.Reeve & Company, London: 570p.

0560 Howard, S.H. 1937. **Forest pocket book, 4th edition**. Forest Research Institute, Dehra Dun: 84p.

Gives briefly the silvicultural characteristics of teak, site requirements and notes on its artificial propagation.

0561 Kanjilal, U. 1969. **Forest flora of the Chakrata, Dehra Dun and Saharanpur Forest Division, U.P. revised by B.L. Gupta**. Fourth Edition 1969: 371p.

Describes *Tectona grandis* under Verbenaceae as introduced species in Dehra Dun and New Forest.

0562 Keiding, H. 1985. **Teak, *Tectona grandis*, Linn. F.** Danida Forest Seed Centre, Denmark, Seed Leaflet 4: 21p.

Nomenclature, tree characteristics, reproductive biology, seed and fruit collection, seed processing, storage, pretreatment and testing are discussed.

0563 Kurz, S. 1877. **Forest flora of British Burma**. Superintendent, Government Printing, Calcutta: 259p.

0564 Ridley, N.H. 1923. **The flora of the Malaya Peninsula**. Vol. 2: 617p.

0565 Roxburgh, W. 1874. **Flora Indica**. Thacker and Spink, Calcutta: 202p.

Go top

Plant Chemistry

(See also 0394, 0411, 0425, 0656, 1397, 2294, 2393, 2927, 3046, 4721, 4744)

0566 Adeyeye, A. 1991. **Composition of seed oils of gmelina (*Gmelina arborea*) and teak (*Tectona grandis*)**. Pakistan Journal of Scientific and Industrial Research 34(9): p359.

0567 Agarwal, S.C; Sarngadharan, M.G; Seshadri, T.R. 1965. **Colouring matter of teak leaves: Isolation and constitution of tectoleafquinone**. Tetrahedron Letter, Oxford 30: 2623-2626.

Mature dry leaves extracted with cold Me_2CO.

0568 Aguinaldo, A.M; Ocampo, O.P.M; Bowden, B.F; Gray, A.I; Waterman, P.G. 1993. **Tectograndone, an anthraquinone naphthoquinone pigment from the leaves of *Tectona grandis***. Phytochemistry 33(4): 933-935.

Tectograndone, a pigment derived from the interaction of two prenylated naphthoquinones has been isolated from the leaves of teak.

0569 Ahluwalia, V.K; Seshadri, T.R. 1957. **Special chemical components of commercial woods and related materials. VI. *Tectona grandis*.** Science and Industry 16B: p323.

Alcohol extract of teak heart-wood yielded 0.1 percent tectoquinone (3. metlhyanthra-quinone), concentration of the ether extract of bark gave about 1 percent of a triterpenoid compound which was identified us betulinic acid.

0570 Ajmal, M; Ali, M.I.M; Anwar, S. 2001. **Sorption studies of heavy metals on teak leaves (*Tectona grandis*) using thin-layer and column chromatographic techniques.** Pollution Research 20(3): 425-428.

0571 Amir Husni, M.S; Mohd Ghazali, H; Suhaimi, W.C; Adzmi, Y. 1996. **Which leaf position in the crown of *Tectona grandis* (teak) should be sampled for fertility (nutritional) evaluation?** Journal of Tropical Forest Science 9(1): 35-43.

The fertility status of leaf tissues of *Tectona grandis* of various age groups and at various positions of the canopy was assessed via foliar sampling and chemical analysis. It is found that elemental levels of N, P, K, Mg, Cu and Zn in the foliage were generally higher in the apex zone, while those of Ca and Mn were higher in the lower tier of the canopy. In general, leaf tissues from either the top or middle tier of the sun-exposed canopy appeared suitable for the evaluation of nutritional status.

0572 Angadi, V.G; Kamala, B.S; Rai, S.N; Parthasarathi, K. 1988. **Effect of deficiency of trace elements on leaf area, chlorophyll level and photosynthetic efficiency in tree-seedlings**. Myforest 24(2): 124-128.

Trace element deficiency was induced in seedlings of 8 species including *Tectona grandis* using a method previously described [Kamala, B.S.; Angadi, V.G.; Parthasarathi, K. Science and Culture 52, 1986: 161-164]. Leaf samples from 8-month-old seedlings were analysed for chlorophyll content, and leaf area and photosynthetic efficiency measured. Data are tabulated for seedlings deficient in Cu, Zn, Mn, Mo and B and for control non-deficient seedlings. All 3 parameters were reduced by deficiency of each trace element. Relations between the parameters and the differential effects of the trace elements are discussed.

0573 Balasubramanian, A; Ravichandran, V.K. 1996. **Allelopathic significance of six agroforestry trees on *Casuarina equisetifolia* growth and nodulation**. Madras Agricultural Journal 83(2): 84-87.

The allelopathic influences of six agroforestry tree species including teak were tested by using extracts of mature leaves in *Casuarina equisetifolia* germination, growth and nodulation. Effects were measured in terms of germination, root and shoot length, dry matter production and vigour index.

Much lower effects was reported for *T. grandis*.

0574 Berquist, G; Rundberg, Og G. 1941. **The occurrence in Sweden of diseases caused by tropical wood**. (Sweedish). Nordisk Hyg. Tidskr 22: 205-220.

Results of a study conducted on allergic inflamations of skin, upper respiratory tract and in conjunctiva of people working with tropical woods are presented. Teak wood is considered as a most frequent cause of such infections. The details of disease and its duration are also discussed.

0575 Bhadoria, H.B.S; Singh, V.P. 1998. **Effect of different treatments on removal of tannins from teak (*Tectona grandis*) leaves**. JNKVV Research Journal 30(1/2): 52-53.

The removal of tannin from teak leaves was studied. Optimum removal was achieved with calcium hydroxide + urea.

0576 Bhattacharjee, A.K; Das, A.K. 1969. **Phytochemical survey of few Mysore plants**. Economic Botany 23(3): 274-276.

The paper presents the screening results for alkaloids, saponins, sterioids, terpenes and tannins of 27 plants of S. Canara district, Mysore, including *Tectona grandis*. In case of teak, when bark was tested it responded for terpenes, saponine and tannins.

0577 Channal, H.T; Kurdikeri, M.B; Sarangamath, P.A. 2000. **Allelopathic effect of tree leaf extracts on germination of sorghum and rice**. Karnataka Journal of Agricultural Sciences 13(2): 338-342.

A study was conducted to evaluate the allelopathic effect of leaf extracts from different tree species which include *Tectona grandis*, all applied 5 and 10 concentration on seed germination, vigour index, seedling length, and seedling dry matter of sorghum and rice. All tree leaf extracts promoted germination in sorghum.

0578 Channal, H.T; Kurdikeri, M.B; Hunshal, C.S; Sarangamath, P.A; Patil, S.A; Shekhargouda, M. 2002. **Allelopathic effect of some tree species on sunflower and soybean**. Karnataka Journal of Agricultural Sciences 15(2): 279-283.

Studies on the allelopathic effect of seven tree leaf extracts including teak at 5 and 10 percent concentration on sunflower and soyabean indicated that germination of sunflower was increased by *Tectona grandis*, *Tamarindus indica* and *Samanea saman*. Seedling length, vigour index and seedling dry matter were also influenced by tree leaf extracts at different concentrations.

0579 Channal, H.T; Kurdikeri, M.B; Hunshal, C.S; Sarangamath, P.A; Patil, S.A. 2002. **Allelopathic influence of tree leaf extracts on greengram and pigeonpea**. Karnataka Journal of Agricultural Sciences 15(2): 375-378.

Fresh leaves of seven tree species including *Tectona grandis* were collected and 5 and 10 percent concentrations of aqueous solutions were prepared. Extracts were tested for their effects on germination of green gram and pigeon pea seeds. Irrespective of the concentrations in green gram, the percent germination was reduced due to *T. grandis*.

0580 Chin, T; Wang, Y. 1947. **The vegetable tannin materials in Taiwan**. Memoirs of Taiwan Forest Research Institute 1: 22-31.

From the trunk bark of teak grown in Formosa the tannin fractions of the total soluble extract determined by Procter's method is 2.09.

0581 Dhand, V; Tripathi, A.K; Manhas, R.K; Negi, J.D.S; Chauhan, P.S. 2003. **Estimation of carbon content in some forest tree species**. Indian Forester 129(7): 918-922.

A study was carried out in the Forest Research Institute Campus in Dehra Dun, Uttar Pradesh to estimate the carbon content of some important species including teak and its responses to the changing climate. *Pinus roxburghii* stored the highest amount of carbon followed by *Pterospermum acerifolium*, *Syzygium cumini* and *Tectona grandis*.

0582 Drechsel, P; Zech, W. 1991. **Foliar nutrient levels of broad-leaved tropical trees: A tabular review**. Plant and Soil 131(1): 29-46.

Foliar nutrients of some 40 tropical and subtropical broadleaved tree species are listed and classified as deficient, low, intermediate, high, and toxic in each case according to the interpretation and evaluation of the author's review. More detailed data are given for *Tectona grandis*.

0583 Estlander, T; Jolanki, R; Kanerva, L. 1999. **Occupational allergic contact dermatitis eczema caused by obeche and teak dusts**. Contact Dermatitis 41(3): p164.

Reported a case of a 56-yr-old non-atopic carpenter from Finland who developed allergic contact dermatitis after working with teak for about 40 years and obeche for about 30 years.

0584 George, J; Kohli, R.C. 1957. **Nitrogen content of the leaves of some Indian trees**. Indian Forester 83(4): 287-288.

Teak leaves collected in July from Dehra Dun reported to have 0.92 percentage of N and 7.28 percentage of ash.

0585 Gopikumar, K; Varghese, V; Vidyasagaran, K. 2001. **Nutrient deficiency studies in teak (*Tectona grandis* Linn.f.) seedlings**. Proceedings of the 13th Kerala Science Congress, State Committee on Science, Technology and Environment, Kerala. M.R. Das, Ed.

0586 Gopikumar, K; Varghese, V. 2004. **Sand culture studies of teak (*Tectona grandis*) in relation to nutritional deficiency symptoms, growth and vigour**. Journal of Tropical Forest Science 16(1): 46-61.

A study is conducted to induce symptoms of deficiency of various nutrient elements in seedlings of teak grown in sand culture. The effects of nutrients on the growth, vigour and nutrient uptake pattern are also investigated.

0587 Grewal, P.S; Sohi, H.S. 1988. **Toxicity of some plant extracts to *Aphelenchoides composticola***. Indian Journal of Nematology 18(2): 354-355.

A. composticola were exposed to 1, 2, 5 and 10 percent concentrations of leaf extract of *Eucalyptus hybrid*, *Leucaena leucocephala*, *Populus deltoides* and *Tectona grandis* for 48, 96 or 144h. Nematode mortality increased with exposure time and concentration with *L. leucocephala* being the most effective.

0588 Gupta, R.S; Patle, B.R. 1991. **Nutritive value of dry fallen teak (*Tectona grandis*) leaves**. Indian Journal of Animal Nutrition 8(1): 67-68.

The contents of dry matter, crude protein, ether extract, crude fibre, nitrogen free extract, total ash, acid insoluble ash, calcium and phosphorus on dry matter basis in dry fallen teak leaves were found out. Average values of digestible crude protein and total digestible nutrients estimated by different methods were 1.44 and 17.82 percent respectively.

0589 Gupta, R.S; Patle, B.R. 1992. **Availability and chemical composition of dry fallen teak (*Tectona grandis*) leaves and possibility of its feeding to ruminants.** Indian Journal of Dairy Science 45(7): 383-384.

Dried, fallen teak leaves contained 7.09 percent crude protein, 22.27 percent crude fibre, 2.81 percent calcium and 0.46 percent phosphorus.

0590 Haupt, M; Leithoff, H; Meier, D; Puls, J; Richter, H.G; Faix, O. 2003. **Heartwood extractives and natural durability of plantation grown teakwood (*Tectona grandis* Linn.f.) - a case study**. Holz als Roh und Werkstoff 61(6): 473-474.

The causes of low natural durability of plantation grown teak from Panama were investigated. A lower content of tectoquinone and a higher one of deoxylapachol is reported in the non durable teakwood.

0591 Hellinga, G. 1955. **The amounts of mineral constituents taken up from the soil by stands of *Tectona grandis* and *Albizia falcata***. (Javanese; Dutch). Rimba Indonesia 4(9/12): 367-377.

Data are given for ash content of the woods of these two species and 31 other species.

0592 Hernandez, R; Torres, A; Marquez, O; Franco, W. 1993. **Foliar nutrient content and growth in teak plantations in Ticoporo, Venezuela**. (Spanish). Turrialba 43(1): 11-15.

The relationship between foliar nutrient content and growth was studied in 12-year-old teak plantations on alluvial soils, in the Venezuelan western plains. The plantation on moderately drained soils showed better growth than the one on poorly drained soils. The K and P foliar contents were significantly greater in the site with moderate drainage, whereas the Mg, Fe and Mn foliar concentration were significantly greater at the poorly drained site. Potassium foliar content was positively correlated with teak growth.

0593 Hooper, D. 1888. **The mineral concretion of the teak tree**. Indian Forester 14(4): 159-161.

The observations of white mineral concretions, mainly lime are reviewed and chemical composition discussed. Watt considers that in teakwood the percentage of carbon and hydrogen are higher than in most woods and with richness of Ca phosphate and silica may account for great hardness of teak. The Nilambur concretion has Calcium carbonate 70.05 percentage, tricalcic orthophosphate 2.89 percentage, quartz sand 9.76 percentage, organic matter 14.30 percentage and moisture 3.0 percentage.

0594 Jadhav, B.B; Gaynar, D.G. 1994. **Effect of *Tectona grandis* (L.) leaf leachates on rice and cowpea**. Allelopathy Journal 1(1): 66-69.

The effects of extracts of dried powdered leaves of *Tectona grandis* were tested on the germination and seedling growth of rice and cowpeas. Germination was significantly reduced in the early stages but less later. The inhibition increased progressively with leaf powder soaking time.

0595 Jain, A; Roychoudhury, N. 1997. **Phytochemistry of teak (*Tectona grandis* Linn. f.): A critical review**. Advances in Forestry Research in India 17: 1-39.

0596 Jain, A; Roychoudhury, N. 2000. **Nutrient assessment in teak leaves of different maturity**. Indian Journal of Forestry 23(2): 155-156.

This work investigated variations in nutrient content of teak leaves of tender, intermediate and mature leaves from a 2-yr-old plant. Leaf moisture content was determined. Leaf protein, chlorophyll, nitrogen, phosphorus, potassium, calcium, magnesium and sodium contents were determined. Moisture content, protein, N, P, K and Na were higher in tender than intermediate and mature leaves. Chlorophyll, Ca and Mg contents were greater in mature than in intermediate and tender leaves.

0597 Jayamadhavan, A; Sudhakara, K; Wahid, P.A. 2000. **Methods of leaf sampling in teak (*Tectona grandis*) for nutrient analysis**. Journal of Tropical Forest Science 12(2): 227-237.

A study was conducted in 10-yr-old teak plantations at Nilambur, Kerala to standardize the canopy height, time of sampling, leaf rank and diameter class of trees from which to collect leaf samples for the determination of N, P and K concentrations. Seasonal variation in the foliar N, P and K concentrations was also determined for a period of 13 months.

0598 Joshi, K.C; Singh, P; Pardasani, R.T. 1977. **Chemical components of roots of *Tectona grandis* and *Gmelina arborea***. Planta Medica 32(1): 71-75.

0599 Jung, H.D. 1967. **Occupational contact eczema with Kambala teak wood**. (German). Deutsche Gesundheitswesen, Berlin 22(45): 2141-2143.

Reports on acute, allergically induced eczema in a workshop; the allergic nature could be proved by skin tests with chips, dust etc. of the wood.

0600 Kenjale, R.Y; Chavan, K.N; Chavan, A.S. 1994. **Recycling of nutrient elements by some forest tree species of Konkan in Maharashtra. I-Foliar and leaf-litter nutrient concentration**. Van Vigyan 32(1/2): 1-6.

The paper describes the results of a study in which mature green leaves and leaf litter were collected from 10-yr-old plantations of seven species, and analysed for content of major nutrients of N, P, K, Ca and Mg. The leaf litter contained less nutrients than green leaves.

0601 Konar, J; Kushari, D.P. 1989. **Effect of leaf leachate of four species on sprouting behavior of rhizomes, seedling growth and diosgenin content of *Costus speciosus***. Bulletin of the Torrey Botanical Club 116(4): 339-343.

The rhizomes of *C. speciosus* were treated with leaf leachates of *Mangifera indica*, *Shorea robusta*, *Tectona grandis* and *Eucalyptus globulus*. Treatment with leaf leachates increased the percentage of sprouting of rhizomes, shortened the sprouting time and promoted subsequent growth except *E. globulus*.

0602 Krishna, A; Manjunath, G.O; Rathod, R; Kannur, S. 2003. **Allelopathic effect of four agroforestry tree species leaf leachates on seed germination of certain vegetable crops**. Karnataka Journal of Agricultural Sciences 16(3): 430-433.

Laboratory experiments were conducted to study the alleopathic effect of leaf leachates of different species including *Tectona grandis* on tomato, aubergine and chilli. The leaf leachates of all trees significantly inhibited germination percentage and growth of vegetable crops.

0603 Krogh, H.K. 1963. **Contact eczema caused by true teak**. British Journal of Industrial Medicine 21(1): 65-68.

Out of 112 furniture factory workers, 21 showed allergic skin reaction to *Tectona grandis* dust, the incidence of contact eczema and severe itching. Patch testing revealed sensitivity to lapachol.

0604 Lalman; Misra, A. 1985. **Nutrient utilization in some tropical forest tree seedlings**. Indian Forester 111(6): 368-384.

The concentration of N, P, K, Ca and Na in seedlings of *Tectona grandis* was evaluated along with other species. Concentration of Na in leaves was higher than that of K, Ca and P and was higher in leaves than in roots and stems. Concentration was found to increase with age of leaves up to 8-9 months after which N, P and K contents decreased rapidly.

0605 Laskar, S; Majumdar, S.G; Basak, B; Maity, C.R. 1985. **Influence of teak (*Tectona grandis*) seed protein on some enzymes and liver lipids of albino rats**. Revista Espanola de Fisiologia 41(3): 331-334.

0606 Leyva, A; Dimmel, D.R; Pullman, G.S. 1998. **Teak extract as a catalyst for the pulping of loblolly pine**. Tappi Journal 81(5): 237-240.

Analysis of teak extract indicated the presence of a variety of napthaquinones and anthraquinones of which 2-methyl anthraquinone was the major component. When used as a catalyst in pulping loblolly pine, the extract was active, based on its 2-methyl AQ content.

0607 Mandal, S; Brahmachary, R.L. 1998. **Growth stimulators in shed leaves of teak (*Tectona grandis*)**. Indian Forester 124(3): 267-269.

Aqueous extracts of dry teak leaves inhibited root and shoot growth of rice seedlings developing from seeds germinated on filter paper soaked in the extracts. Two inhibitors and two stimulators were identified in the extracts after paper chromatographic separation.

0608 Marwani, E; Kobayashi, A; Kajiyama, S.I; Fukusaki, E; Nitoda, T; Kanzaki, H; Kawazu, K. 1997. ***Tectona grandis* callus produces antibacterial triterpene acids not detected in the intact plant**. Natural Product Sciences 3(1): 75-80p.

0609 Masilamani, P; Dharmalingam, C; Annadurai, K. 2002. **Inhibitory effect of water extracts of epicarp and mesocarp of teak on germination of some field crops**. Indian Journal of Forestry 25(1/2): 39-41.

The extracts from mesocarp teak seeds exhibited a significant influence on the germination of soyabean and cowpea seeds but not on rice, sorghum, black gram or green gram. This was because of the presence of some water soluble germination inhibitors in the felty mesocarp.

0610 Nakamura, K. 2002. **Protoplast isolation from leaf teak (*Tectona grandis*)**. (Japanese). Japan Kokai Tokkyo Koho JP 2002253220 A2, 10th September 2002: 4p.

0611 Patil, R.H; Itnal, C.J; Hunshal, C.S. 2003. **Allelopathic effect of tree litter leachates on wheat crop**. Journal of Maharashtra Agricultural Universities 28(2): 182-184.

A laboratory experiment was conducted to determine the effects of eucalyptus, casuarinas and teak tree leachates on wheat seeds. The germination percentage, shoot and root length and shoot and root dry weight per plant were recorded.

0612 Pramono, S. 1995. **Phytochemical and pharmacological approaches of plant ethnobotany used for anti-diarrhea**. Proceedings of the Second National Seminar and Workshop on Ethnobotany, Yogyakarta, Medicinal Plant, Book 1, 1995. R.E. Nasution; H. Roemantyo; E.B. Walujo, S. Kartosedono, Eds.

Phytochemical and pharmacological study of plants revealed that 90 species of plant have been utilized for anti-diarrhea. It is found that their phytochemical properties are suit well with their pharmacological effect, such as *Areca catechu, Psidium guajava* leaf and teak charcoal.

0613 Puri, G.S. 1954. **Foliar constituents in some tree species of *Shorea robusta* forests of the Siwaliks, U.P. India**. Indian Forester 80(11): p700.

Gives the chemical composition of mature leaves of *Tectona grandis* in the sal forest of Dun valley.

0614 Puri, G.S; Gupta, A.C. 1954. **Seasonal variation in foliar composition of some Indian forest trees**. Journal of Indian Botanical Society 33(4): 382-393.

A study of seasonal variation in foliar ash, Ca, Mg and N in *Tectona grandis* was conducted along with other species.

0615 Rajput, K.S; Rao, K.S. 1999. **Seasonal distribution of starch in *Tectona grandis* Linn.f. and *Acacia nilotica* (L.) Del. growing in different forests of Gujarat state.** Phytomorphology 49(2): 209-214.

The distribution of starch was examined using histochemical methods in xylem, cambium and phloem tissues of *Tectona grandis* growing in moist deciduous and dry deciduous forests of Gujarat state. Starch grains were found in ray cambial cells of

Tectona. Their size, distribution and stainability increased concomitantly with the maturation of leaves in both the forests.

0616 Rao, P.S; Misra, A.K; Puri, S.K. 1966. **Dyestuff from teak leaves**. Indian Forest Leaflet 178: 8p.

Reports experiments in the extraction of dyestuff from the leaves and its use in dyeing wool, silk, and cotton, with data on costs and equipment required for cottage-scale industry.

0617 Sareen, V; Jain, S; Narula, A. 1995. **Evaluation of oestrogenicity and pregnancy interceptory efficacy of lapachol (2-hydroxy-3-(3-methyl-2-butenyl)-1,4-naphthoquinone) in the mouse**. Phytotherapy Research 9(2): 139-141.

Lapachol, a naphthoquinone isolated from the heartwood of *Tectona grandis*, was evaluated for its oestrogenicity and antinidational activities in ovariectomized mice. Significant uterophic effects were observed following daily administration of lapachol.

0618 Shirin, F; Sarkar, A.K. 2003. **Removal of phenolic exudates from explants of *Tectona grandis***. Teaknet Newsletter 30: 4-6.

Phenolic exudates from cut ends of explants pose a great problem for establishment of in vitro cultures of *Tectona grandis* and have become the main bottleneck for development of a micropropagation procedure for the species. The collected explants were administered with 0.1 percent solution of various inorganic/organic compounds and adsorbents and activated charcoal prior to their surface sterilization.

0619 Singh, U.P; Singh, S.K; Pathak, N.K.R; Rao, A.L.J; Sarma, B.K. 2002. **Effect of lapachol on conidial germination of *Alternaria tenuissima* (Kunze ex Pers.) Wiltshire, inciting blight of pigeon pea (*Cajanus cajan* (L.) Millsp.)**. Journal of Mycology and Plant Pathology 32(2): 255-257.

About 200-300 conidia of *A. tenuissima* causing blight in pigeon pea were treated with lapachol isolated from *Tectona grandis* to determine the effects of the compound on the conidial germination of the pathogen *in vitro*. *A. tenuissima* conidial germination and germ tube length decreased with increasing concentrations of lapachol *in vitro* and *in vivo*. It is reported that at 2000 ppm, lapachol inhibited the conidial germination of the pathogen.

0620 Sinha, U.S.P; Sinha, A.K. 1993. **Amino acids in the leaves of *Tectona grandis* and Zizyphus *mauritiana*, the secondary food plants of tasar silkworm, *Antheraea mylitta* D.** Indian Journal of Sericulture 32(2): 223-224.

The amino acid compositions of leaves of *Tectona grandis* and *Zizyphus mauritiana* were analysed. The total amino acid contents of teak was 69 100. There were 15 amino acids common to both plants. Arginine, histidine, glutamine, tyrosine and methionine sulfoxide were only found in *T. grandis*.

0621 Sujatha, M.P. 2003. **Diagnosis of micronutrient deficiencies in teak seedlings**. KFRI Research Report 249. Kerala Forest Research Institute, Peechi.

A study was conducted to diagnose the deficiency symptoms of Fe, Cu, Zn, Mn, Mo and B in teak seedlings using sand culture. Deficiency of micronutrients resulted in the retardation of plant growth. The reduction in height at severe stage of deficiency was more in Mo and Cu deficient plants and minimum in B deficient plants.

0622 Swaminathan, C; Sivagnanam, K; Srimathi, P. 1993. **Allelopathic proclivities of multipurpose trees**. Myforest 29(2): 147-149.

An investigation of the allelopathic effects of extracts from the bark of eight multipurpose trees including teak on three arable crops was made and the results are presented.

0623 Sylianco, C.Y.L; Jocano, A.P; Lim, C.M. 1988. **Antimutagenicity of twenty Philippine plants using the micronucleus test in mice**. Philippine Journal of Science 117(3): 231-235p.

Methylmethanesulfonate, mitomycin C and dimethylnitrosamine are genotoxic to bone narrow cells, since they fragment the chromathin material leading to the formation of micronucleated polychromatic erythrocytes in bone narrow cells of experimental mice. Expressions from different species including *Tectona grandis* Linn.f. reduced the induction of micronucleated polychromatic erythrocytes by methylmethanesulfonate, mitomycin C. and dimethylnitrosamine indicating that these plants have antimutagenic effects.

0624 Tripathi, S; Tripathi, A; Kori, D.C. 1999. **Allelopathic evaluation of *Tectona grandis* leaf, root and soil aqueous extracts on soy-**

bean. Indian Journal of Forestry 22(4): 366-374.

The allelopathic activity of *Tectona grandis* was studied in bioassays on the germination, seedling growth, nodulation, and chemical and biochemical parameters of soyabean seeds and seedlings. The extracts exhibited a stimulatory effect on peroxidase activity and nodulation of seedlings and on seed protein. Root extracts enhanced peroxidase activity. Leaf extracts increased nodulation.

0625 Webb, M.J; Reddell, P; Nath, S; Srivastava, R.J. 2001. **Determining P and N status of a tropical timber species (teak): Assessment of 'quick' chemical tests and a root phosphatase assay**. Plant nutrition: Food security and sustainability of agro ecosystems through basic and applied research. Fourteenth International Plant Nutrition Colloquium, Hannover, Germany: 706-707. W.J. Horst; M.K. Schenk; A. Burkert; N. Claassen; H. Flessa; W.B. Frommer; H. Goldbach; H.W. Olfs; V. Romheld, Eds. Kluwer Academic Publishers, Dordrecht, Netherlands.

Assessed the suitability of 'quick' chemical test strips and an assay of root phosphatase activity for assessing the P and N status of seedlings of teak. These tests confirmed the adequacy of nutrient status. The activity of root phosphatase was sensitive to P status; decreasing rapidly with increasing P status. Phosphatase activity can be used to determine the severity of deficiency.

0626 Windeisen, E; Klassen, A; Wegener, G. 2003. **On the chemical characterisation of plantation teakwood from Panama**. Holz als Roh und Werkstoff 61(6): 416-418.

Chemical composition, especially the qualitative and quantitative analysis of extractives focusing on the derivatives of anthraquinone and lapachol is compared of teakwood from two plantations of Panama .

0627 Winter, K; Holtum, J.A.M. 2002. **How closely do the delta13C values of Crassulacean acid metabolism plants reflect the proportion of CO2 fixed during day and night?** Plant Physiology 129(4): 1843-1851.

The extent to which Crassulacean acid metabolism (CAM) plant delta13C values provide an index of the proportions of CO2 fixed during day time and night time was assessed. Shoots of seven CAM species and two C3 species including *Tectona grandis* were grown in a cuvette and net CO2 exchange was monitored and the results are presented.

0628 Yamamoto, K; Simatupang, M.H. 1996. **Location of caout chouc in teak**. Forestry and forest products research: Proceedings of the Third Conference, 3-4 October 1995, Kepong. Volume 2: 247-254. A.M. Abdul Rashid; Abdul Rahim Nik; Aminuddin Mohamad; Lee SuSee; Wong HanHoy; Khoo KeanChoon, Eds. Forest Research Institute Malaysia, Kuala Lumpur.

Thin sections of teak heartwood were extracted with acetone or acetone and chloroform and analysed by X-ray photoelectron spectroscopy. The water repellency of the wood surface was significantly reduced during successive extraction with acetone and chloroform. Caoutchouc extracted with chloroform is responsible for the water repellency of teak wood.

0629 Yamamoto, K; Simatupang, M.H; Hashim, R. 1998. **Caout chouc in teak wood (*Tectona grandis* Linn.f.): Formation, location, influence on sunlight irradiation, hydrophobicity and decay resistance**. Holz als Roh-und Werkstoff 56(3): 201-209.

The distribution of this polyisoprenoid in untreated and extracted heartwood, its influence on surface chemistry, contact angle with water and formation of radicals before and after irradiation with sunlight and on decay resistance were determined.

0630 Yamamoto, K; Simatupang, M.H. 2000. **Formation of caout chouc by wound in teak xylem**. Conference on forestry and forest products research 1997: Proceedings of the Fourth Conference, Malaysia, 24 October 1997: 168-173. S. Appanah; S.Y.M. Yusoff; A.W. Jasery; K.K. Choon, Eds. Forest Research Institute Malaysia, Kuala Lumpur.

Caoutchouc is formed during the transition from sapwood to heartwood in teak xylem. Formation of caoutchouc in response to wounding was examined under microscopy.

0631 Zech, W. 1984. **Leaf analysis - a method to detect mineral deficiencies in fast growing plantations of West Africa**. Proceedings IUFRO Symposium on Site and Productivity of Fast Growing Plantations, Volume 2: 691-699. South African Forest Research Institute, Pretoria, South Africa.

Instances of boron, nitrogen, phosphorus, potassium, zinc and calcium deficiencies are reported for plantations of different species which include *Tectona grandis* in West Africa.

0632 Zech, W; Kaupenjohann, M. 1990. **Potassium and phosphorus deficiencies of *Casuarina equisetifolia*, *Eucalyptus* spp., *Acacia auriculiformis* and *Tectona grandis* in south Benin (West Africa).** (French). Bois et Forests des Tropiques 226: 29-36.

In order to analyse nutrient deficiencies, foliage samples were taken from trees of fuelwood plantations of fast-growing species. Teak growing on vertisols exhibited reduced vigour due to periodic flooding, but no deficiency symptoms. Teak growing on acid ferralitic soils had P and K deficiency symptoms such as chlorosis, necrosis and dieback. It is reported that root decay due to waterlogging may be responsible for these symptoms.

Go top

Plant Physiology

(See also 0716, 0719)

0633 U**nusual flowering of teak seedlings**. Indian Forester 47(4), 1921: p166.

Reported an unusual flowering of 5-6 months old seedlings from Prome Division, Burma.

0634 Bhatnagar, H.P. 1967. **Physiology of forest trees**. Proceedings of 11th Silvicultural Conference, Dehra Dun 1967.

Studies on the nutritional requirements of the seedlings of *Tectona grandis* indicated 4000 lbs./acre of Potassium and Nitrogen, and 200 lbs./acre of Phosphorous.

0635 Bhola, M.P. 1929. **Flowering of teak in Gorakpur**. Indian Forester 55(11): p623.

Reports the flowering of a 1926 teak plantation in 1928 after being planted with one year old stumps. Small sized seeds are produced in January-February 1929, and nuts were smaller than average, 0.2" in diameter, and quantity of seed per sapling few, 2-3 dozens.

0636 Bila, A.D; Lindgren, D; Mullin, T.J. 1999. **Fertility variation and its effect on diversity over generations in a teak plantation (*Tectona grandis* Linn.f.).** Silvae Genetica 48(3/4): 109-114.

Flower and fruit production were used to assess plant fertility in a teak stand in southern Mozambique. The trees varied in fertility, with the 20 percent most fertile trees in the stand producing 55 percent of the gametes. Formulae to calculate inbreeding, group coancestry and status number over generations were derived. Predictions over 10 generations, assuming random mating, showed that inbreeding and group coancestry accumulated rapidly during the first generations while status number decreased. This loss of diversity was hastened by differences in fertility among parents. A way to reduce the loss of diversity suggested was to collect equal amounts of seeds from each seed parent contributing to the next generation.

0637 Boonkird, S. 1966. **Flowering of teak**. Natural History Bulletin of the Siam Society 21(1/2): 69-74.

The paper gives a short account of flowering habit of teak in relation to its effect on branching and height growth and concludes that early flowering among young teak is probably herditary.

0638 Costa, W.A.J.M de; Abeysinghe, W.A.M.W.K.S.B; Chandrapala, A.G. 2000. **Relationship between stomatal conductance and leaf water potential in selected forest tree species growing under different levels of natural shade in the mid-country wet zone**. Journal of the National Science Foundation of Sri Lanka 28(1): 63-78.

Nine forest tree species including *Tectona grandis* growing under different levels of natural shade, i.e. open, medium shade and full shade, were used for measurements. Total leaf conductance (g1) and leaf water potential (PSI) varied significantly with tree species and shade levels.

0639 Coster, C. 1932. **Studies of roots in the tropics 1 and II**. (Dutch; English; German). Tectona 25(9): 641-645; 828-872.

0640 Coster, C. 1933. **Studies of roots in the tropics III**. (Dutch; English). Tectona 26: 450-497.

The factors influencing growth of plants by root competition are lack of (1) soil moisture (2) mineral food and (3) oxygen and perhaps secretion of toxins by the roots. Experiments with variation of above factors in a teak plantation bordering an old forest are described - the problem of root competition was highlighted. It is reported that Lantana reduces increment of teak upto 32 percent, *Leucaena glauca* is the only mixture considered beneficial to teak.

0641 Coster, C. 1935. **Root studies in one tropics-V**. (Dutch; English). Tectona 28(11): 861-878.

0642 Grace, J; Fasehun, F.E; Dixon, M. 1980. **Boundary layer conductance of the leaves of some tropical timber trees**. Plant, Cell and Environment 3(6): 443-450.

The boundary layer conductance was determined by measuring the rate of cooling of brass models of leaves exposed in a wind tunnel. The models were based on juvenile and adult leaves of *Gmelina arborea* and leaves of teak and *Triplochiton scleroxylon*; the teak leaf models were made either with or without projecting veins. Results suggest that teak and *Gmelina* leaves avoid excessive rise in temperature by high stomatal conductance and transpiration.

0643 Kaikini, D.S. 1934. **Branching of teak**. Indian Forester 60(9): 614-615.

Incidence of branching in teak plantations attributes branching to (1) very poor soils on which plantations are grown, (2) damage caused by creepers and climbers by encircling and smothering the leading shoot, and (3) origin of seed, e.g. pole-size teak forest origin from Gund area.

0644 Karmacharya, S.B; Singh, K.P. 1992. **Production and nutrient dynamics of reproductive components of teak trees in the dry tropics**. Tree Physiology 11(4): 357-368.

Floral axes were sampled periodically from 14 and 30-yr-old teak stands growing in the Chakia Range of Varanasi Forest Division, Uttar Pradesh. Flower production per tree was positively related to tree size. Annual production of reproductive components was 245 kg/ha in the 14-yr-old stand and 1122 kg/ha in the 30-yr-old stand. In both stands, relatively greater amounts of dry matter and nutrients were allocated to reproductive parts in September than in other months. Towards the end of the fruit maturation period, considerable nutrient resorption occurred. More than 90 percent of the nutrients accumulated in the peduncle were resorbed.

0645 Madsen, E. 1975. **Determination of moisture content in fruits of teak (*Tectona grandis* Linn.f.)**. (Danish). Beretning fra Statsfroekontrollen 104: 103-108.

0646 Maruyama, Y; Toma, T; Ishida, A; Matsumoto, Y; Morikawa, Y; Ang, L.H; Yap, S.K; Iwasa, M. 1997. **Photosynthesis and water use efficiency of 19 tropical tree species**. Journal of Tropical Forest Science 9(3): 434-438.

Gas exchange measurements were made on one fully expanded mature leaves on each of five seedlings of eleven dipterocarp species and eight non-dipterocarps in a shaded nursery in the Chikus Forest Reserve, Perak, Malaysia. Calculations were made of net photosynthetic rate, transpiration rate, water use efficiency and leaf dry weight per unit area. Water use efficiency was highest in three species including *Tectona grandis* occurring naturally in the northern part of Malaysia. The results are discussed in relation to species choice for various site types.

0647 Matsumoto, Y. 2002. **Leaf physiology of tropical forest trees (3) intrinsic water-use efficiency**. (Japanese). Tropical Forestry 55: 67-71.

Data are presented on water use efficiency for various tropical tree species including *Tectona grandis*.

0648 Nanda, K.K. 1962. **Some observations on growth, branching behaviour and flowering of teak (*Tectona grandis* Linn.f.) in relation to light.** Indian Forester 88(2): 207-218.

The emergence of branches and their flowering appear to be related to ageing or completion of the developmental process of the main shoot or the branch on which these are produced. The first branch emerges from the node immediately below the previous year's inflorescence, and the second one from the node next below it and so on. The flowering of these branches also follows the same order, and this basipetal sequence of emergence and flowering is exhibited even by secondary, tertiary, quaternary, and further branches.

0649 Negi, G.C.S; Singh, S.P. 1992. **Leaf growth pattern in evergreen and deciduous species of the central Himalaya, India**. International Journal of Biometeorology 36(4): 233-242.

Leaf growth patterns were investigated in 11 evergreen species and in 15 deciduous species including teak occurring in Uttar Pradesh. Leaf initiation period, leaf population dynamics, leaf expansion, leaf mass changes, leaf longevity and some other related parameters were investigated over different months/seasons . The results for both groups are compared and discussed.

0650 Ngampongsai, C. 1973. **The distribution and development of teak-root in different age plantations**. (Thai). Faculty of Forestry, Kasetsart University, Thailand, Forest Research Bulletin 28: 63p.

It was found that the rate of increase of the root system declined with increasing age; the roots were confined to the upper 30 cm of the soil surface; with increasing age the tap root lost its ability to penetrate and lateral and vertical roots then developed profusely. Above-ground and below-ground parts of the trees were compared; the patterns of growth were different, but an approximate weight ratio of 5:1 is suggested.

0651 Prasad, R; Mishra, G.P. 1984. **Studies on root system of important tree species in dry deciduous teak forests of Sagar (M.P.)**. Indian Journal of Forestry 7(3): 171-177.

The dimensions of the root systems were measured for eleven sample trees of teak and three associated species. Lateral spread was greatest in *A. latifolia*, followed by *T. tomentosa*, teak and *D. melanoxylon*. Stout and deep tap roots were observed in teak and *T. tomentosa*. Secondary and tertiary roots were prominent but sparse in teak and *T. tomentosa*. The relations between root and crown spread were analysed. In nearly all cases horizontal root spread was greater than crown spread. It is concluded that frequent uprooting in teak is caused by its relatively larger crown. An equation is given for calculating above-ground biomass of teak from root and crown spread.

0652 Rajendrudu, G; Naidu, C.V. 1997. **Leaf gas exchange capacity in relation to leaf position on the stem in field grown teak (*Tectona grandis* Linn.f.).** Photosynthetica 34(1): 45-55.

Leaf gas exchange patterns in relation to leaf positions on stems were studied in field grown forest tree, teak during first year growth under intensive culture plantation. Net photosynthetic rates were low in immature leaves, increased basipetally on shoot. High photosynthetic rate found in fully expanded young leaves was associated with increased dark respiration rate and high radiation saturation as well as compensating irradiance for photosynthetic rate when compared to those of aged leaves. An increase in mesophyll limitations or decrease in carboxylation efficiency could explain gradual reduction in photosynthetic potential with leaf age after maturation in teak.

0653 Rajendrudu, G; Naidu, C.V; Mallikarjuna, K. 1999. **Effect of water stress on photosynthesis and growth in two teak phenotypes**. Photosynthetica 36(4): 627-630.

Two teak phenotypes differing in their leaf length/breadth ratios were subjected to water stress by withholding water supply for three weeks. Growth rates of whole plants, developing leaves and internodes were higher in the broad leaved phenotype than in the narrow leaved phenotype before and after imposing water stress treatment. The effect of water stress on these parameters was higher in the broad leaved phenotype than in the narrow leaved one. Photosynthetic rate, stomatal conductance and transpiration rate in both phenotypes were negatively affected by water stress and their decline under water stress was significantly higher in the broad leaved than narrow leaved plants.

0654 Rajendrudu, G; Naidu, C.V. 1999. **Induction of shoot growth in teak (*Tectona grandis* Linn.f.) during dormancy periods**. Indian Forester 125(3): 293-300.

This paper gives a brief review of the regulation of shoot growth in woody plants by internal and environmental factors, and then discusses the possibilities for inducing shoot growth during teak dormancy periods in commercial plantations. Such a mechanism could also be used for expanding forestry and agroforestry practices using teak in India.

0655 Singh, G.J.R. 1960. **Peculiar phenological behaviour of teak in South Madras**. Indian Forester 86(8): p488.

Reports of a local strain of teak in the Ramnad and Tirunelveli districts, which differs morphologically from other forms and flowers and fruits at different seasons from Nilambur or South Coimbatore teak. It reaches 20 ft. in height and 6 in. d.b.h. Coppice shoots grow readily and reach this height in 4-5 years, but then stagnate. A good return is gained by clear felling the pure stands every 6-10 years, and marketing the poles.

0656 Singh, K.P; Srivastava, S.K. 1986. **Seasonal variation in the biomass and non-structural carbohydrate content of fine roots of teak (*Tectona grandis* Linn.f.) plantations in a dry tropical region.** Tree Physiology 1(1): 31-36.

Roots were collected monthly for one year from plantations in the Varanasi Forest Division, Uttar Pradesh. Total non-structural carbohydrate content (TNC) of fine roots was highest during the dry summer and lowest in the early part of the rainy season. Seasonal trends in fine root biomass were opposite to those in TNC, with minimum in May and maximum in September. TNC content of roots increased with diameter and decreased with soil depth, and was about 12 percent higher in the 19-yr-old than in the 29-yr-old plantation.

0657 Siripatanadilok, S. 1973. **The development of flower in teak (*Tectona grandis* Linn. f.)**. (Thai). Thesis: 68p. Kasetsart University, Bangkok.

0658 Siripatanadilok, S. 1974. **Development of teak flower (*Tectona grandis* Linn.f.)**. (Thai). Forest Research Bulletin, Faculty of Forestry, Kasetsart University, Thailand 31: 71p.

A description of flower development during the 40 days from the formation of inflorescence primordia to fruit maturation.

0659 Srivastava, S.K; Singh, K.P; Upadhyay, R.S. 1986. **Fine root growth dynamics in teak (*Tectona grandis* Linn.f.)**. Canadian Journal of Forest Research 16(6): 1360-1364.

Seasonal variations in the standing crop (live and dead) of fine roots, and below ground net production and turnover were studied in a 19-yr-old teak plantation in the Varanasi Forest Division, Uttar Pradesh. Total root mass increased rapidly during the rainy season, reached a peak in September, then gradually declined to minimum in May except for a minor peak in February. Maximum teak root biomass occurred at 10-20 cm depth. Annual mean fine root biomass was 5420 kg/ha and annual net production was 5460 kg/ha.

0660 Sunitibala, Y; Gupta, S; Mukherjee, B.B. 1998. **Effect of sucrose on growth and chlorophyll synthesis of teak shoots in mixotrophic culture**. Journal of Plant Biochemistry and Biotechnology 7(1): 57-59.

Clonally propagated shoots of teak were cultured in vitro under photomixotrophic and photoautotrophic conditions in MS medium containing kinetin and benzylaminopurine. Sucrose concentrations were gradually depleted in mixotrophic cultures. In sucrose-free medium, shoot growth and chlorophyll synthesis in leaves decreased after 2-3 subcultures, whereas they were stimulated under photomixotrophic conditions with 10-30 g sucrose.

0661 Sutarja, D.S. 1977. **Correlation between water balance with radial growth in *Tectona grandis* Linn.f., *Shorea selanica* Bl and *Pinus merkusii* Jungh. et de Vriese. (Indonesian).** Buletin Berita Ikatan Alumni Fakultas Kehutanan Institut Pertanian Bogor 1-2: 16-19 .

0662 Thit, A.T. 1921. **Flowering of teak**. Indian Forester 47(8): p350.

A teak tree 23" in height and 2.5" in girth is observed to bear both flowers and fruits.

Go top

Go top

Plant Embryology

0663 Dabral, S.L. 1977. **Polyembryony in teak**. Indian Forester 103(10): 694-695.

A note reporting 0.5 percent incidence of polyembryony in germination tests on teak.

0664 Gunaga, R.P; Nagesh Prabhu, H; Surendran, T. 2004. **Variation in cotyledon number and phyllotaxy in seedlings of teak (*Tectona grandis* Linn.f.)**. Indian Forester 130(2): 235-236.

0665 Niranjan, P. 1950. **Studies on the embryogeny of some verbenaceae**. Journal of the Indian Botanical Society 30: p59.

0666 Pal, N. 1951. **Studies in the embryology of some Verbenaceae**. Journal of Indian Botanical Society 30: 59-74.

The paper describes the development of the flower and female gametophyte in teak and other two species and development of endosperm in *Tectona grandis*.

Go top

Plant Morphology, Anatomy and Histology

(See also 0900, 2586)

0667 **Bending of wood and bamboos**. Forest Research in India Part I 1951-52, 1952: p64.

Tests showed that teak wood is a poor-bender.

0668 Adarsh Kumar. 1973. **Studies on seedling evaluation of teak**. Forestry conference (Silvicultural Conference) 6-10 December 1973, 66. Forest Research Institute, Dehra Dun.

The work on seedling evaluation of teak has been reported in this paper. Various morphological characters associated with normal and abnormal seedlings have been described. On the basis of results obtained 9 categories of abnormal seedlings have been indicated.

0669 Baden-Powell, B.H. 1879. **A teak tree with alternate leaves**. Indian Forester 5: p328.

0670 Bagchi, S.K. 1999. **Correlations of age element in *Tectona grandis***. Indian Forester 125(5): 522-525.

Measurements were made of five characteristics total and bole height, diameter and girth at breast height, and crown length in 80 sets of teak trees. Each set contained 6 phenotypically superior trees from different locations in plantations in Tamil Nadu, Kerala and Karnataka. An analysis was made of correlation coefficients between pairs of characters with age as a separate character and without age. The results showed that age need not be considered for analytical purposes.

0671 Barcenas, A; Salazar, R. 2000 . **Phenology of important forest species in Honduras**. (Spanish). II Simposio sobre avances en la produccion de semillas forestales en America Latina: Memorias, Santo Domingo, Republica Dominicana, 18-22 de octubre 1999: 25-28. Centro Agronomico Tropical de Investigacion y Ensenanza, Turrialba, Costa Rica.

Phenological data are presented for different species including *Tectona grandis*.

0672 Beekman, H. 1917. **An anatomical investigation of annual ring development in *Tectona grandis***. (Indonesian). Tectona 10: 320-328.

0673 Bhat, K.M. 1998. **Cambial activity and juvenile wood formation in teak**. KFRI Research Report 137: 41p. Kerala Forest Research Institute, Peechi.

Determined the growth periodicity and factors influencing it during juvenile wood production, including false ring formation, the age at which teak stops producing juvenile wood and begin to form mature wood, and evaluated the differences in size and proportion of different secondary xylem elements, microfibrillar angle, specific gravity and bending strength between juvenile and mature wood.

0674 Bisset, I.J.W; Dadswell, H.E.Y; Amos, G.L. 1950. **Changes in fibre length within one growth ring of certain Angiosperms**. Nature 165(4192): 348-349.

A preliminary survey is made on fibre length variation within one growth zone of some timbers including teak and the results are tabulated.

0675 Brascamp, E.H.B. 1925. **Rings of teak trees in 1686, Uit het Kolonial Archief No. XLIII.p.822**. Tectona 15: 422-423.

0676 Cardoso, N.da S. 1991. **Characterisation of the wood anatomical structure, phenology and relations with the cambial activity of teak trees (*Tectona grandis* Linn.f.), verbenaceae.** Piracicaba, SP (Brazil): 133p.

0677 Chacko, K.C; Kedharnath, S; John, C.H. 2000. **Incidence of phyllotaxy variants in teak (*Tectona grandis* Linn.f.)**. Indian Forester 126(3): 314-316.

The occurrence of three types of phyllotaxy is reported in an experimental plantation raised using stumps in Kerala. Of 4509 plants observed for 25 months from sprouting, normal opposite decussate phyllotaxy was exhibited by 99.33 percent, whorled phyllotaxy by 0.60 percent and alternate phyllotaxy by 0.07 percent.

0678 Chowdhury, K.A; Rao, K.R. 1949. **The formation of growth rings in Indian trees part iv. False growth rings in saplings of teak (*Tectona grandis*) and Mahogany (*Switenia macrophylla*)**. Indian Forest Records (n.s.) Wood Technology 1(1): 15p.

Usually teak saplings produce incomplete or discontinuous false growth rings. The anatomical structure of the false rings has been studied in details and is recorded here. In rare cases, teak saplings may produce complete but false growth marks, which are anatomically similar to the true growth marks.

0679 Classen, J.C van R. 1908. **Rings of teak**. (Indonesian; English). Tectona 1/2: 125p.

0680 Coster, C. 1926. **A curious growing together of two teak stems**. (Indonesian; English). Tectona 19: 170-171.

The cause of growing together of two stems might be due to falling of one stem in the fork of another. At the place of contact the bark of both trees dried off and wound tissue was formed bringing the two limbs together. Consequently the flow of the sap of one of the stems was altered, causing the growth to be altered.

0681 D'Almeida, J.F.R; Desai, J.L. 1942. **A contribution to the study of the ecology foliar anatomy of Indian plants**. Journal of University, Bombay (Sci. No.) 10(5): 1-58.

A study was made of the anatomical features of the leaves of some Indian plants from Salsette, a typical monsoon region, with reference to the effect of environment on leaf anatomy. Descriptions of the leaf anatomy of various plants are preceded by notes on the general character of the species under review. The tree species dealt with including *Tectona grandis*.

0682 Fernandez, E.E. 1879. **Rings in teak wood; are they necessarily annual**. Indian Forester 4(4): 355-358.

0683 Geiger, F. 1915. **Anatomical investigations of annual ring development in *Tectona grandis***. Jahrbuch Fur wissenschafiche Botanik 55.

0684 Grace, J; Okali, D.U.U; Fasehun, F.E. 1982. **Stomatal conductance of two tropical trees during the wet season in Nigeria**. Journal of Applied Ecology 19(2): 659-670.

Measurements of stomatal conductance were made on teak and *Gmelina arborea* during the wet season in Nigeria. Stomatal conductance was mainly determined by the quantum flux. Transpiration rates were calculated from the stomatal conductances, using the Penman-Monteith equation. The rates were high and imply that almost all the net radiation was used to evaporate water.

0685 Griffith, A.L. 1946. **The stomates and early growth of some timber trees of the Malabar Coast**. Indian Forest Records (n.s.) Silviculture 6(2): 62-92.

Describes a series of investigations on the leaves and their stomates and the early growth of some of the principal timber trees including *Tectona grandis* of the Malabar coast of India. Some of the main conclusions drawn from the investigations are described.

0686 Gunaga, R.P; Surendran, T. 2002. **Leaf morphological variations in teak (*Tectona grandis* Linn.f.) clones.** Evergreen 48: 8-9.

The leaf morphological features of 9 month old clonal plants belonging to 15 different clones of teak established at the Central nursery in Chettikkulam, Kerala are tabulated. Results indicate that there exists considerable phenotypic variation between plus trees of teak.

0687 Hooper, E.D.M. 1880. **On a teak tree with alternate leaves**. Indian Forester 5: p328.

A curio teak with alternate leaves grown in Telenkheri gardens at Nagpore from Malabar seed origin of 1877.

0688 Jacoby, G.C Jr; D'Arrigo, R.D. 1990. **Teak (*Tectona grandis* Linn.f.), a tropical species of large-scale dendroclimatic potential**. Dendrochronologia 8: 83-98.

A 400-year tree growth ring width time series of teak from central Java is examined, focusing on radial growth responses of teak to climate. Comparison of the series with rainfall data indicated the importance of the dry and transitional seasons on radial growth. There was correspondence between climatic responses of Java teak and data for teak in India. Both chronologies exhibited positive correlations with rainfall during the transitional months between the wet and dry seasons of the monsoon. The potential value of dendrochronological studies in tropical regions is discussed.

0689 Jaijing, D. 1994. **Variation on certain morphological characteristics and annual ring growth of *Tectona grandis* Linn.f.** Kasetsart University, Bangkok: 125 leaves.

0690 Joshi, M.D; Kelkar, S.P. 1971. **Germination of seed in dry teak (*Tectona grandis* Linn.f.). (1) Preliminary studies in fruit development and seed dormancy.** Indian Forester 97(4): 210-215.

Studies were made on the anatomy of the fruit and the viability of seeds of teak from the Khapa range, Nagpur Division. Usually only one seed was fully developed in each quadrilocular fruit. It is suggested that inhibition of apparently developed seed may be caused by a restriction of the O_2 supply to the seed during development, possibly by lignin deposition in the fruit. The nature of the tubular structures and scope for further studies are discussed.

0691 Kedharnath, S. 1963. **Phyllotaxy variants in teak**. Indian Forester 89(2): p125.

The paper describes two unusual phyllotaxy variants of teak, one with alternate leaves and the other with whorls of three leaves at every mode.

0692 Kjaer, E.D; Kajornsrichon, S; Lauridsen, E.B. 1999. **Heartwood, calcium and silica content in five provenances of teak (*Tectona grandis* Linn.f.)**. Silvae Genetica 48(1): 1-3.

Heartwood percent and content of silica and calcium were estimated in a 17 year old provenance trial of teak at St. Croix, Virgin Islands. Average contents of silica was significantly different between provenances ranging from 0.27 to 0.66 percent. Percentage of heartwood and content of calcium were also significantly different between provenances and significantly correlated to tree size. Large trees had the highest heartwood percentage, but the lowest calcium content.

0693 Krishnaswamy, V.S; Mathauda, G.S. 1954. **Phenological behaviour of a forest species at New Forest, Dehra Dun**. Indian Forester 80(3): 124-153.

An investigation of the phenological behaviour of some tree species including teak growing at Dehra Dun was made. The characters investigated were renewal of leaves, leaf fall, deciduous or evergreen habit, and availability of ripe fruit or seeds.

0694 Manning, D.E.B. 1931. **Abnormal teak plant**. Indian Forester 57(11): p579.

Illustrates two plants from Yanaungmyin reserve, Pyinmana Division. In one, leaves are alternate instead of opposite as far as first branch, below which leaf scars show leaves are normal and opposite after forking each side has alternate leaves. Abnormal leaves have two central veins instead of one, while all the alternate leaves are not of this type.

0695 Osundina, M.A; Osonubi, O. 1989. **Adventitious roots, leaf abscission and nutrient status of flooded Gmelina and Tectona seedlings**. Tree Physiology 5(4): 473-483.

The possibility that adventitious roots alleviate mineral deficiency, limit accumulations of toxic minerals or delay leaf abscission in flooded plants, was investigated in a greenhouse study using *Gmelina arborea* and *Tectona grandis*.

0696 Pande, J.K. 1933. **Branching of teak in plantations**. Indian Forester 59(6): 345-347.

The tendency of teak plantations for forking and development of branches is described, occurring both in pure and bamboo mixed plantations. Forking observed even in single stems has persistent thick lower branches is attributed to light frost attacking leading shoot or drought affecting circulation of sap, which will reduce rate of vigour and growth of main stem. Author advocates judicious pruning of forked stems and thick persistent branches.

0697 Pande, J.K. 1934. **Forking of teak plants**. Indian Forester 60(5): p374.

The author does not agree forking due to grazing or browsing as it is observed in an effectively protected plantation also. He attributes damage to tops to frost and advocates against creating large clear fellings and leaving adequate standards to break up the frost level.

0698 Rajput, K.S; Rao, K.S. 1997. **Occurrence of sieve elements in phloem rays**. IAWA Journal 18(2): 197-201.

Solitary sieve elements or groups of sieve elements were encountered in the rays of secondary phloem of *Erythrina indica, Guazuma tomentosa, Acacia nilotica*, *Azadirachta indica* and *Tectona grandis* trees. These elements were short and possessed simple and compound sieve plates on their transverse to slightly oblique end walls. The detailed structure and possible significance of these elements are discussed.

0699 Rao, K.S; Dave, Y.S. 1981. **Seasonal variation in the cambial anatomy of teak**. Nordic Journal of Botany 1: 535-542.

0700 Rao, V.S. 1952. **The floral anatomy of some Verbenaceae with special reference to the Gynoecium**. Journal of Indian Botanical Society 31(4): 297-315.

The vascular anatomy of thirteen species of Verbenaceae is studied with the view of determining the inter relationships and evolutionary trends within the family. There are reductions in the calyx, androecium and gynoecium. On grounds of floral anatomy the species studied are classified into primitive and evolved.

0701 Rios R, C.A. 1979. **Generalities macroscopic and microscopic description of teak (*Tectona grandis* Linn.f.)**. (Spanish). Universidad Nacional de Colombia, Medellin (Colombia): 50p.

0702 Rutten, L. 1911. **Abnormal leaf in teak**. Tectona 4: 242-243.

0703 Sankar, S.J; Wahid, P.A; Kamalam, N.V. 1988. **Absorption of soil-applied radiophosphorus by black pepper vine and support tree in relation to their root activities**. Journal of Plantation Crops 16(2): 73-87.

Root activity patterns of *Piper nigrum* vines trailed on *Erythrina* standards and on teak poles were compared in field experiments employing a 32P soil-injection technique. In both cases, over 90 percent of the root activity was found within a 30 cm radius around the vine. The root activity of vines trailed on teak poles was more at 40 cm than in the upper soil layers. Vines trailed on teak poles absorbed more 32P than vines trailed on *Erythrina* standards.

0704 Shah, J.J; Unnikrishnan, K. 1969. **Bud trace connections in *Tectona grandis* Linn.f.** Current Science 38(12): 298-299.

Describes and illustrates diagrammatically the peculiar features of the vascular system of the bud, node and internode in teak.

0705 Singh, K.P; Srivastava, S.K. 1984. **Spatial distribution of fine root mass in young trees (*Tectona grandis*) of varying girth sizes.** Pedobiologia 27(3): 161-170.

Lateral and vertical distributions of fine root mass was studied in teak trees of 5 to 40 cm girths. Sampling was done in peak growing season at three distances from the tree base down to 40 cm depth. The composite root mass was separated into live teak roots, teak root necromass, herb root mass and soil organic matter. The amount of root mass distinctly varied with tree girth, sampling distance and soil depth.

0706 Singh, P.K; Sivaji, V. 2001. **Emptiness and seededness in teak (*Tectona grandis* Linn. f.) fruits**. Journal of Research, Birsa Agricultural University 13(1): 113-115.

Teak fruits collected from three provenances were categorized into three classes: large fruits, medium fruits and small fruits. Fruits collected from each provenance were split and the number of seeds present in each chambers were counted. The percentage of empty fruits gradually increased with the decrease in fruit size in all the three provenances. Among the seeded fruits, the maximum number of fruits were the one-seeded in all the provenances and size classes.

0707 Soeters, K. 1911. **The teak plant with abnormal leaves**. Tectona 4: p835.

0708 Srimathi, R.A; Emmanuel, C.J.S.K. 1984. **A conjointed quadruplet teak seedling**. Myforest 20(4): p245.

A brief description is given of a quadruplet seedling raised during seedling production for a provenance trial. The seedling had a single slender root system, 4 stems and different numbers, sizes and shapes of leaves and cotyledonary leaves on the different stems. Two of the seedlings in the quadruplet were well grown and the others average and poor.

0709 Suri, S.K. 1964. **Some foliage measurements of *Tectona grandis* (teak)**. Indian Forester 90(8): 529-534.

A study was made of the shape and size of leaves from a single tree, and of the numbers and fresh weights of leaves on nine trees. Foliage varied from sixty leaves weighing 0.7 kg. on a sapling of 3.2 in. g.b.h. to 3830 (41.7 kg.) on a tree of 30.5 in. g.b.h. A regression equation for leaf area based on length and width is presented.

0710 Vakshasya, R.K; Emmanuel, C.J.S.K. 1984. **An abnormal seedling in teak**. Indian Forester 110(5): 497-498.

A single deviant seedling was observed when a seed lot from Nilambur was germinated. A white patch, indicating chlorophyll deficiency, was noted on one cotyledon and on one of each of the first eight pairs of leaves. The potential use of such features as genetic markers is discussed.

0711 Venkateswaran, S. 1939. **Teak abnormality**. Indian Forester 65(1): 36-38.

An abnormal phyllotaxy of leaves was observed in coppice shoots coming from thinned shoots, and is attributed to environmental factors rather than inheritance by seed origin.

0712 Venugopal, B; Krishnamurthy, K.V. 1994. **Seasonal pattern of cell division in the vascular cambium of some tropical timber trees**. Cytologia 59(3): 323-332.

Studies were carried out on 3- to 5-yr-old stem twigs collected every two weeks for two years, for some tropical trees including *Tectona grandis* and the results are presented.

0713 Venugopal, N; Krishnamurthy, K.V. 1988. **Occurrence of multinucleate cambial initials in some tropical trees**. Current Science 57(21): 1174-1175.

A description of nuclear behaviour and the occurrence of multinucleate cells in the cambial initials of four deciduous trees including *Tectona grandis* and two evergreen species is given.

0714 Versluis, W. 1922. **A teak tree with lobed leaves**. (Dutch; English). Tectona 15: 263-264.

The author describes a case of *Tectona grandis* Linn.f. with lobed leaves instead of the usual entire edged ones.

0715 Wangcharoen, K. 1964. **Correlation between leaf weight and age of teak**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Leaf weight at the age of 10-20 years is significantly correlated to age, and correlation factor r=0.85 and regression equation Y=1.3384=0.485x.

0716 Whitehead, D; Okali, D.U.U; Fasehun, F.E. 1981. **Stomatal response to environmental variables in two tropical forest species during the dry season in Nigeria**. Journal of Applied Ecology 18(2): 571-587.

Measurements were made of stomatal conductance of *Gmelina arborea* and *Tectona grandis*. Stomatal conductance increased rapidly in the early morning and decreased after midday in both species but values in *G. arborea* were less than those in *T. grandis*. Leaf water potential was lower in Gmelina than in teak. Stomatal conductance in both species was mainly controlled by irradiance and air saturation deficit.

Go top

Dendroclimatology

0717 Berlage, H.P.(Jr). 1931. **The relationship between thickness of year-rings and rainfall in teak forests in Java**. (Indonesian). Tectona 24: 939-953.

0718 Bhattacharya, A; Yadav, R.R. 1999. **Climatic reconstructions using tree-ring data from tropical and temperate regions of India - a review**. Dendrochronology in Monsoon Asia. Proceedings of a workshop on Southeast Asian Dendrochronology, Chiang Mai, Thailand, 16-20 February 1998. D. Eckstein; P. Baas, Eds. IAWA Journal 20(3): 311-316.

Tree ring studies have been used in the tropical and Himalayan region in India to develop millennium-long climatic reconstructions. Several tropical trees in India produce annual growth rings due to a distinct seasonality in moisture supply. Some of these species like teak have datable growth rings and are useful in understanding the long-term monsoon variability in India.

0719 Catinot, R. 1970. **Preliminary thoughts on a possible physiological explanation of the annual growth rhythms of trees in the African tropical forest**. Bois et Forests des Tropiques 131: 3-36.

Explained the correlations between the annual growth rhythms of trees and the factors: day-length, duration of exposure to sunshine and the quantity of energy received, rainfall, temperature and atmospheric moisture saturation deficit.

0720 Champion, H.G. 1934. **Seasonal progress of height growth in trees**. Indian Forest Bulletin 88.

0721 Devall, M.S; Parresol, B.R. 2003. **A dendrochronological study of teak (*Tectona grandis* Linn.f.) in Puerto Rico**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

A dendrochronological study of the species has been made to investigate patterns of growth and to determine the effect of climate on the growth of teak and compared the growth of teak with that of *Hibiscus elatus*. It is found that teak growth is better than that of *Hibiscus*.

0722 Fujiwara, T; Pant, G.B; Kumar, K.R; Borgaonkar, H.P; Sickder, A.B. 2002. **Dendroclimatic response of ring-width chronologies of teak from eight sites in Central India**. IAWA Journal 23(4): p463.

0723 Murphy, J.O. 1994. **A dendroclimatic study of teak from East Java**. Proceedings of the Koninklijke Nederlands Akademie van Wetenschappen. Biological, Chemical, Geological, Physical and Medical Sciences 97(2): 183-199.

A dendroclimatic investigation has been made into an extended teak tree ring-index chronology from East Java. Significant correlations have been established between teak growth rates and precipitation, based on meteorological records up to 1960 from two locations in East Java. Growth correlated negatively with the number of dry months prior to the new growth season.

0724 Nobuchi, T; Janmahasatien, S; Sakai, M. 1996. **Seasonal changes of wood formation and some characteristics of heartwood formation in teak (*Tectona grandis* Linn.f.) plan-**

tation. Kasetsart Journal, Natural Sciences 30(2): 254-263.

Heartwood and sapwood formation and properties, anatomy and elemental analysis investigated in relation to season, topography, soil moisture content and seasonal changes in leaf area, in 22-yr-old plantation grown teak in a typical monsoon area in northern Thailand. Soil moisture content was higher in the rainy season, and leaf budding started at the beginning of the rainy season.

0725 Ohta, S. 1997. **High resolution of dendroanalysis on the environment and climate from tropical trees**. Tropical Forestry 39: 2-11.

Includes data on dendrochronological studies of wood including *Tectona grandis*.

0726 Palmer, J.G; Murphy, J.O. 1993. **An extended tree ring chronology (teak) from Java**. Proceedings of the Koninklijke Nederlands Akademie van Wetenschappen. Series C, Biological and Medical Sciences 96(1): 27-41.

A 416-yr chronology for *Tectona grandis* in Java, compiled in 1931, has been extended to 1989. Analysis of the chronology showed a dominant near-50-yr cycle in growth patterns.

0727 Priya, P.B; Bhat, K.M. 1998. **False ring formation in teak (*Tectona grandis* Linn.f.) and the influence of environmental factors.** Forest Ecology and Management 108(3): 215-222.

Seedling anatomy and cross sectional discs of 8- and 12-yr-old teak trees in plantations at Nilambur, Kerala were examined for growth ring analysis and determination of environmental factors responsible for false ring formation. The results showed that rainfall during dry periods, drought during the active growing season, polybag/field transplantation of seedlings and juvenility are the important causative factors of frequent false rings in teak. False ring formation in teak appears to be mainly a resultant feature of growth ring responses to different environmental and physical factors.

0728 Priya, P.B; Bhat, K.M. 1999. **Influence of rainfall, irrigation and age on the growth periodicity and wood structure in teak (*Tectona grandis*).** IAWA Journal 20(2): 181-192.

Growth periodicity was followed for two consecutive annual cycles to reveal the pattern of wood formation in plantation-grown teak at three different localities in India. Rainfall and age were found the two factors that influenced cambial activity. Juvenile trees and those grown in relatively high rainfall areas had a prolonged cambial activity and retained foliage throughout the year. They produced wider rings with higher proportions of latewood.

0729 Pumijumnong, N. 1995. **Dendrochronology with teak (*Tectona grandis* Linn.f.) in northern Thailand**. Fachbereich biologie, Hamburg: 109p. Hamburg University, Germany.

0730 Pumijumnong, N. 1999. **Climate growth relationships of teak (*Tectona grandis* Linn.f.) from northern Thailand**. Tree ring analysis: Biological, methodological and environmental aspects: 155-168. R. Wimmer; R.E. Vetter, Eds. CABI Publishing, Wallingford.

0731 Pumijumnong, N; Park, W.K. 1998. **Reconstruction of Southeast Asian monsoon using anatomical variables and teak tree rings**. Abstracts of the Fourth Pacific Regional Wood Anatomy Conference, 'New horizons in wood anatomy on the threshold of a new millennium', 26-29 October, Kwangju, South Korea.

Anatomical characteristics of earlywood and latewood of teak growing in northern Thailand show high correlations with precipitation and temperature variables. The ring-width chronology shows only correlations with precipitation. A regression equation incorporating earlywood vessel diameter and ring-width chronologies was used to reconstruct May-July precipitation. Latewood vessel density was used to reconstruct April-May temperature. Stepwise multiple regression was employed for calibration and could be verified with independent data.

0732 Pumijumnong, N; Park, W.K. 1999. **Vessel chronologies from teak in northern Thailand and their climatic signal**. Dendrochronology in Monsoon Asia. Proceedings of a Workshop on Southeast Asian Dendrochronology, Chiang Mai, Thailand, 16-20 February 1998. D. Eckstein; P. Baas, Eds. IAWA Journal 20(3): 285-294.

Five teak trees in northern Thailand were selected for the study of vessels in terms of dendroclimatology. Investigations are made to understand how strongly the vessel characteristics related to climate and

how these relationships different from those of ring widths. All vessel parameters of the total ring and of the earlywood were negatively correlated with precipitation during the transitional period between the dry and the wet season. The latewood vessel parameters are negatively correlated with June temperature. The climatic signals of the vessel parameters and of the tree-ring width are different from each other.

0733 Rajput, K.S; Rao, K.S. 1998. **Seasonal anatomy of secondary phloem of teak (*Tectona grandis* Linn.f. Verbenaceae) growing in dry and moist deciduous forests.** Phyton Horn 38(2): 251-258.

The seasonal development of secondary phloem anatomy was studied in samples of bark collected from *Tectona grandis* growing in the moist and dry deciduous forests of Gujarat state. In both forest types active cambial cell division and differentiation of phloem began in June when the dormant shoot buds opened. In the moist deciduous forest, phloem developed more rapidly than xylem at the beginning of growth season. The structure and development of secondary phloem are discussed with other developmental phenomena occurring within the tree.

0734 Rao, K.S; Rajput, K.S. 1999. **Seasonal behaviour of vascular cambium in teak (*Tectona grandis*) growing in Moist Deciduous and Dry Deciduous Forests.** IAWA Journal 20(1): 85-93.

Seasonal behaviour of vascular cambium in *Tectona grandis* growing in Moist Deciduous Forests and Dry Deciduous Forests of Gujarat State in Western India was studied for one annual cycle. In both the forests active cambial cell division and simultaneous differentiation of xylem and phloem started in June when the dormant shoot buds opened. Maximum radial growth in trees of both forests occurred during the monsoon period. Phloem differentiation ceased before xylem differentiation in both the forests. During dry months and the leafless periods the cambium remained dormant. In both forests, the seasonal anatomical changes associated with the cambium closely followed the phenology of the tree and local climatic conditions.

0735 Ruengthanom, Q.S. 1961. **Correlation between teak growth and the quantity of rainfall in September and October (1950-59)**. (Thai). Student Thesis. Kasetsart University, Bangkok.

No relationship was observed between the quantity of rainfall and growth of teak during the period 1950-59 when observed in April-May 1960.

0736 Tomazello, M; Cardoso, N.da S. 1999. **Seasonal variations of the vascular cambium of teak (*Tectona grandis* Linn.f.) in Brazil**. Tree ring analysis: Biological, methodological and environmental aspects: 147-154. R. Wimmer; R.E. Vetter, Eds. CABI Publishing, Wallingford.

0737 Yadav, R.R; Bhatacharya, A. 1996. **Biological inferences from the growth climate relationship in teak from India**. Proceedings of the Indian National Science Academy. Part B Biological Sciences 62(3): 233-238.

Tree ring samples of teak collected from dry deciduous forest in Korzi, Andhra Pradesh, were analysed to work out its dendroclimatic potential - especially in the reconstruction of monsoon variability. A ring width chronology was developed from nine radii of five trees. The response function analysis carried out showed a strong direct relationship between growth and precipitation, indicating that teak chronologies could provide valuable data for understanding long-term monsoon variability in India.

Go top

Genetics and Breeding

(See also 1086)

0738 **National Seminar on Tree Improvement, 8 January 1981**. Tamil Nadu Agricultural University, Department of Forestry, Coimbatore, Tamil Nadu, 1981: 122p.

Twenty one papers were presented in the seminar held at Kumarapumal Farm Science Centre, Tiruchirapalli. An introductory paper gives a resume of tree improvement work in Tamil Nadu University and a paper on improvement of teak also included.

0739 Akinsanmi, F.A. 1976. **Variation in the growth characteristics of teak (*Tectona grandis* Linn.f.) in south-western Nigeria.** Nigerian Journal of Forestry 6(1/2): 12-14.

0740 Apichart Kaosa ard. 1993. **Teak breeding and propagation strategy in Thailand**. Proceedings of the Workshop on Production of Genetically Improved Planting Materials for

Afforestation Programmes, Coimbatore, 18-25 June 1993, 7-RAS/91/004: 67-75. K. Vivekanandan; K.N. Subramanian; N.Q. Zabala; K. Gurumurthy, Eds.

0741 Apichart Kaosa ard. 1996. **Domestication and breeding of teak (*Tectona grandis* Linn.f.)**. Forestry Department, Philippines, No. FAO-FO-RAS-91-004: 63p.

0742 Apichart Kaosa ard. 1999. **Teak (*Tectona grandis* Linn.f.): Domestication and breeding**. Teaknet Publication 5/1999: p86.

0743 Apichart Kaosa ard; Chanpaisaeng, S. 1992. **Teak breeding strategy in Thailand**. Proceedings of the Seminar on 50 Anniversary of Huay-Tak Teak plantation, Bangkok, 5-8 August 1992.

A tree improvement strategies is outlined for Thailand. Major constraints in tree improvement of teak are low seed production areas as well as in seed orchards and a low yield at seeding from available seed.

0744 Bagchi, S.K; Sharma, V.P; Gupta, P.K. 1989. **Developmental instability in leaves of *Tectona grandis***. Silvae Genetica 38(1): 1-6.

Developmental instability of *T. grandis* clones from Uttar Pradesh, Karnataka, West Bengal and Kerala and from Laos was studied in the top, middle and lower crown strata by asymmetry and 2 kinds of intraleaf variability of vein distribution. Instability varied among clones, trees and zones. Instabilities of leaf parts were positively and highly correlated with each other. Variation in the magnitude of different instability indices of various clones was seen as evidence of a common genetic mechanism.

0745 Bhat, K.M. 2001. **Breeding for improved wood quality of teak**. Genetics and Silviculture of teak: 147-163. A.K. Mandal; S.A. Ansari, Eds. International Book Distributors, Dehra Dun.

Teak breeding programmes should include improvement of growth rate, straightness, height and girth of the tree as well as wood structure and properties that dictate the timber quality criteria. Basic knowledge of wood property variations is a prerequisite for selection of desired traits in breeding. While the tree form has received considerable attention of teak breeders in the past, modification of basic wood structure and properties appears to be a new challenge. The paper focuses particular attention on the latter in reviewing the wood quality aspects while tree/bole form is discussed briefly.

0746 Brown, A.G; Palmberg, C.M (Eds). 1978. **Third World Consultation on Forest Tree Breeding. Session 3. Population improvement**. (French; English). CSIRO, Canberra: 475-748.

Five invited special papers included are on *Pinus taeda* and *P. elliottii* in the southern USA, *P. patula, P. elliottii* and *P. taeda* in southern Africa, *Tectona grandis*, eucalypts and *P. radiata* in Australasia.

0747 Brown, A.G; Palmberg, C.M (Eds). 1978. **Third World Consultation on Forest Tree Breeding. Session 1. Exploration, utilization and conservation of gene resources**. CSIRO, Canberra: 112p.

Four invited special papers on genetic conservation, and gene resources of tropical pines and teak, eucalypts and poplars and four voluntary papers are included.

0748 Bryndum, K. 1968. **Genetic research of teak**. Proceedings of the first Silvicultural Seminar, Royal Forest Department R.118: 10-17.

The improvement work on teak carried out at the Teak Improvement Centre at Ngao, Lampang are described under clonal tests, provenance trials, progeny tests and nursery research. The vegetative propagation methods were discussed in detail. The controlled pollination trials undertaken are described and problems encountered in isolation and emasculation are presented. The teak seed germination problems are also discussed.

0749 Chalmers, W.S. 1962. **The breeding of pine (*Pinus caribaea* Mor.) and teak (*Tectona grandis* Linn.f.) in Trinidad: Some early observations**. Eighth British Commonwealth Forestry Conference, East Africa, 1962: 10p. Government Printing Office, Trinidad.

Factors considered in the selection of teak and pine plus trees are outlined. Of several methods of vegetative propagation tried, budding is found better for teak. Clonal trials have been tried for both species to test the genotype of the selected plus trees. Plants are being raised from seed collected from open-pollinated plus trees for use in progeny trials.

0750 Champion, H.G. 1931. **Teak abnormalities**. Indian Forester 57(1): 103-107.

Seven abnormalities were observed in a plantation and the probable cause due to mutation is discussed. Illustrated abnormalities are (1) Cabbage form-its proportionate internode development, (2) leaves ternately

whorled (3) leaves normal but alternate and spirally arranged on a straight stem, (4) leaves normal but alternate and bifarous on a zig-zag stem, (5) leaves alternate appearing derived from fusion of two leaves, (6) leaves mostly normal but one or more pairs fused, and (7) leaves more or less divided.

0751 Champion, H.G. 1933. **The importance of seed origin in forestry**. Indian Forest Records (Silviculture Series) 16(5): 76p.

Information from all over the world is summarised. In the chapter on geographical races specially relevant to teak author remarked that teak occurs in a number of geographical races with well-defined characteristics in appearance and development, and Burma stock has grown up advantageous in several widely scattered places.

0752 Chuntanaparb, L. 1972. **Planning breeding programme for tropical hard wood**. Special study of Faculty of Forestry, 1972: 25p. Kasetsart University, Bangkok.

The importance of a tree breeding programme for tropical forestry has been pointed out. The guide lines for establishing and developing operational tree improvement programme based on modern plant breeding theory and practice have been presented. General considerations on choosing the species, securing immediate seed supplies, selecting of plus trees, establishing seed orchards, and long term research programmes have been reviewed, and discussed extensively. Planning operational breeding programmes for tropical hardwoods have been proposed using teak. Finally the importance of intra and international co-operation has been stressed.

0753 Coster, C; Eidmann, F.E. 1934. **Selection of teak (*Tectona grandis* Linn.f.)**. (Dutch; English). Tectona 27(1): 1-45.

The research comprises comparison of seed from 8 origins in British India, Burma, Siam, Indochina and 4 origins from Java and 3 from special Java and one from Moena (Celebes) Islands. The cultivation methods under taungya with *L. glauca* is described. The seed of different origins is described and weights are recorded. Germination problem and progress in research also outlined. Vegetative characteristics of different origins are discussed and laboratory germination tests involving suction force of seed, oxygen requirements of root system, transpiration of leaves etc, are also given.

0754 Coster, C; Hardjowasono, M.S. 1935. **Selection of teak (*Tectona grandis* Linn.f.) II. Growth during the second year**. Korte Meded Boschbouw Proefsta 49; Tectona 28(1): 3-21.

Gives details of growth of different teak varieties and height and diameter growth, form of bole, branching habit, leaf shedding etc. Thinning requirements are discussed and it is concluded Java teak is best and varieties from Siam, Indochina and Burma may be useful in places where Java teak tends to be branchy and subjected to wind damage, and as a protection against wind-Malabar teak is suggested.

0755 FAO. 1966. ***Tectona grandis* Linn.f. (Teak). Information from countries of origin**. FAO Secretariat, Rome.

Based on morphological characteristics, listed the geographical extent, ecologicial conditions, and distinguishable characters of nine seed origins from India. Information is also recorded for provenance trials and long-established plantations of exotic origin. The countries interested in new introductions or future provenance trials are listed.

0756 FAO. 1974. **Report on the FAO/DANIDA training course on forest tree development, Limuru, Kenya, 24 September-20 October 1973**. FAO Report FAO-DEN-TF 112: 344p.

Topics of principles of variation, selection and inheritance, the relations of heredity and environment, species and provenance trials, seed source classification, seed collection, handling and certification, individual selection, seed orchards, progeny trials, breeding for disease resistance, the economics and planning of tree improvement programmes and international programmes in forest gene resources are covered. Case histories are presented on *Pinus caribaea* and *Tectona grandis*.

0757 Forest Research Institute, Dehra Dun. 1934. **Summary of reports on the All-India teak seed origin investigation**. Proceedings of the 4th Silvicultural Conference, Dehra Dun.

0758 Forest Research Institute, Dehra Dun. 1951. **Research report: Plant breeding-Forest Research Institute and Colleges, Dehra Dun**. Agriculture Research, Indian Council of Agriculture Research 1: p1; 47-60; 152-158. Forest Research Institute, Dehra Dun.

The study of wood characters of teak in seedlings of different origins indicated variation within and between provenance groups.

Chromosome counts made in seedlings for North Burma showed 2n=36. Selfing and cross pollination studies are in progress.

0759 Forest Research Institute, Dehra Dun. 1954. **The importance of seed origin: Summary of results to date of the All India Co-operative teak seed origin investigation**. Proceedings of the 9th Silvicultural Conference, Dehra Dun. Forest Research Institute, Dehra Dun.

0760 Forest Research Institute, Dehra Dun. 1962. **Plant breeding research teak, Forest Research Institute and Colleges, New Forest, Dehra Dun**. Agriculture Research, Indian Council of Agriculture Research 2: 22-30; 166-173; 241-246. Forest Research Institute, Dehra Dun.

Plus trees of teak were selected for crossing. A study is being made of the variation in fibre length and specific gravity of wood of teak. Crosses between *Tectona hamiltoniana* and *Tectona grandis* were made.

0761 Gogate, M.G; Gujar, D; Mandal, A.K; Sharma, R; Lal, R.B; Gupta, B.N. 1997. **Genetic analysis of quantitative characters in teak: (*Tectona grandis*)**. Annals of Forestry 5(2): 165-167.

Progenies of 18 half-sib families of teak were evaluated for height, diameter and basal area over 8 years at Mohoghata Research Station, Maharashtra. Analysis of data revealed non-additive gene action for height and additive gene action for diameter and basal area. Moderate to moderately high estimates of heritability and genetic gain were obtained for diameter and basal area including highly significant genetic correlation for these two traits.

0762 Gram, K; Larsen, C.S. 1960**. The flowering of teak (*Tectona grandis*) in aspects of tree breeding, based on observations in Thailand.** FAO Teak Sub-Commission, New Delhi FAO/TSC-60/3.2, 1960: 4p.

Discusses the effect of flowering habit on the growth form of teak, individual differences in the length of the juvenile period and the possibility that these differences may be genetically conditioned.

0763 Gunaga, R.P; Vasudeva, R; Hanumantha, M; Swaminath, M.H. 2000. **Blooming variation among clones of different provenances in teak**. Myforest 35: 237-246.

A study was taken up to estimate the blooming synchrony among clones of teak seed orchard and to understand its implication to the fruit production.

0764 Hamzah, Z. 1977. **History of teak plant breeding**. (Indonesian). First Symposium on Breeding in Agriculture, Indonesia, 1977. Vol. 2: 22-36.

0765 Harahap, R.M.S. 1977. **Broad-sense heritability of some characters in teak**. (Indonesian). Laporan, Lembaga Penelitian Hasil Hutan 260: 12p.

0766 Hartono, W; Harahap, R.M.S; Suhendi; Alrasjid, H. 1978. **Tree breeding in Indonesia**. Third World Consultation on Forest Tree Breeding, Session 3, Population improvement: 707-715. A.G. Brown; C.M. Palmberg, Eds. CSIRO, Canberra, Australia.

A brief review of breeding programmes for teak is given along with other species .

0767 Hedegart, T. 1967. **Intensive breeding in forest trees with special reference to teak**. Proceedings of Seminar on Forest Seed and Tree Improvement in Thailand: 3p. Teak Improvement Centre, Nago, Thailand.

0768 Hedegart, T. 1967. **Variation and selection in forest tree with special reference to teak**. Proceedings of Seminar on Forest Seed and Tree Improvement in Thailand: 4p. Teak Improvement Centre, Nago, Thailand.

0769 Hedegart, T. 1971. **Teak forestry in Togo-consultancy report to FAO suggestions for improvement**. Thai-Danish Teak Improvement Centre, Ngao: 9p.

Teak has been planted under highly varying environmental conditions in Togo, since beginning of this century. Based on observations in these generally small and scattered plantation plots, suggestions concerning future teak forestry in Togo are summarised.

0770 Hedegart, T. 1972. **Teak (*Tectona grandis* Linn.f.): Breeding efforts in Thailand**. Teak Improvement Centre, Ngao, Thailand: 9p.

The history of teak forests and their exploitation in Thailand was traced and the breeding programmes carried out by Teak Improvement Centre since its inception under the heads (1) provenance research (2) selective breeding selection and seed orchards, selection and demarcation and management of seed source areas, progeny tests, flowering and pollination studies etc.) were discussed and described in detail.

0771 Hedegart, T. 1972. **The Thai-Danish Teak Improvement Centre-five years after initiation**. Vanasarn 30(1): p21.

Information includes silvicultural, nursery and laboratory research, and provenance research of teak. The chapter on breeding includes the selective breeding, vegetative propagation, clone collections, and seed-orchard work of Teak Improvement Centre. It also describes seed source areas, flowering and pollination studies, and finally silvicultural research, nursery and laboratory research, education of counterparts and adoption of other species of importance for investigations and report on Pine project.

0772 Kaushik, R.C. 1960. **Teli variety of *Tectona grandis***. Proceedings of the 9th Silvicultural Conference, Dehra Dun 1956 (Pt. II): 92-94.

Describes a new variety of teak first noted in a 1923 plantation raised in Kanara (Mysore State) but also since found scattered in the natural forest. Leafing, flowering and fruiting are all much earlier, growth is definitely faster and cleaner, and the wood is harder to work and oilier. Nursery experiments are in progress to test the heritability of these characters.

0773 Kedharnath, S. 1963. **Present status of forest tree breeding in India**. FAO, World Consultation of Forest Genetics and Tree Breeding, Stockholm Vol. II FAO/FORGEN 7/6.

Briefly reviews the work in progress on the breeding with teak, samul, red sanders, chir pine, wattles and eucalypts. The major effort is focused on the genetic improvement of teak. The chromosome number of teak is 2n-36. The breeding programme includes selection of plus trees and establishment of clonal seed orchards for important provenances of teak; selection of trees for resistance to the attack of leaf skeletoniser (*Hapalia machaeralis*); parent progeny testing of selected trees and controlled pollination between selected trees and also interspecific hybridisation between *Tectona grandis* and *T. hamiltoniana*.

0774 Kedharnath, S. 1967. **Genetics and forest tree breeding**. Proceedings of 11th Silvicultural Conference, Dehra Dun. Forest Research Institute, Dehra Dun.

Reports on tree improvement work concerning mainly teak, semal and chir pine with the objective of evolving improved strains with inherent vigour of growth, good form and other desired breeding characters. The work done on teak and chir pine during the last five years is reviewed. The report on teak covers the heads selection of plus trees, establishment of seed orchards, controlled pollination experiments and interspecific hybridization.

0775 Kedharnath, S. 1974. **Genetic improvement of forest tree species in India**. Breeding researches in Asia and Oceania. Proceedings of the Second General Congress of the Society for the Advancement of Breeding Researches in Asia and Oceania. Session VII. Breeding of tropical tree species: 367-374. Ramanujam, S; Iyer, R.D; Gupta, B.K, Eds. Indian Society of Genetics and Plant Breeding, New Delhi.

A brief review is given of the breeding work in India on *Tectona grandis*, *Pinus roxburghii*, *Bombax ceiba*, *Pterocarpus santalinus* and *Eucalyptus* species. Induced polyploidy and mutagenesis are very briefly considered in a number of genera.

0776 Kedharnath, S; Jaiswal, P.L; Wadhwani, A.M; Rajinder, S; Chhabra, N.N; Hallan, S (Eds). 1983. **Genetical research in India**. 358p. Indian Council of Agricultural Research, Publications and Information Division, New Delhi.

One of four volumes describing genetic and related research in India and published to mark the XV International Congress of Genetics held at New Delhi on December 12-21, 1983. There is one paper of forestry interest: Kedharnath, S. Genetics and forest-tree breeding. 18-190. Tree breeding strategies employed in India include the exploitation of natural variation and the testing of hybrids. Work on teak, *Bombax ceiba*, eucalypts and chir pine is described briefly.

0777 Kedharnath, S; Raizada, M.B. 1961. **Genetics and forest tree breeding**. Proceedings of 10th Silvicultural Conference, Dehra Dun, 1961 Part II: 203-214.

Reviews the work on teak genetic improvement currently being carried out in the forest genetics section of the Forest Research Institute at Dehra Dun. Chromosome number of teak has been determined. Grafting and budding has been successfully done in teak.

0778 Kerbert, H.J. 1908. **On the origin of teak forests**. Tectona 1: 580-585.

0779 Kertadikara, A.W.S; Prat, D. 1995. **Isozyme variation among teak (*Tectona grandis* Linn.f.) provenances**. Theoretical and Applied Genetics 90(6): 803-810.

Fourteen isoenzyme systems were analysed in leaf parenchyma of nine native and introduced populations of teak from Thailand, Java, Ivory Coast and Tanzania. These enzyme systems were encoded by 20 putative loci of which 18 were polymorphic. Populations showed a general lack of heterozygosity. The cluster analysis showed two main gene pools, the first consisted of the Indian provenances and the second of African, Indonesian and Thai provenances.

0780 Kertadikara, A.W.S; Prat, D. 1995. **Genetic structure and mating system in teak (*Tectona grandis* Linn.f.) provenances**. Silvae Genetica 44(2/3): 104-110.

Genetic variability in teak has been previously analysed quite exclusively in provenance or progeny tests using quantitative traits. Few data were available on genetic diversity revealed by genetic markers. Isoenzyme banding patterns in 14 enzyme systems was assessed using leaf tissue of seedlings from 9 populations, including 1 population which consisted of 10 open-pollinated progenies, from India, Indonesia, Thailand, Cote d'Ivoire and Tanzania.

0781 Kjaer, E.D; Siegismund, H.R; Suangtho, V. 1996. **A multivariate study on genetic variation in teak (*Tectona grandis* (L.))**. Silvae Genetica 45(5/6): 361-368.

Genetic differentiation between populations of teak was examined in nine quantitative characters and ten allozyme loci. Large differences between populations were revealed in the quantitative traits. Regional patterns were revealed by multivariate analysis of the data, but there were also substantial variation within ecological-geographical defined regions. Differentiation between provenances from Laos was less than the variation within Thailand, West India and Indonesia. A much less pronounced differentiation between populations was found in allozyme markers. The fixation index was only 4 percent, and no clear geographical pattern was found in the allozyme data.

0782 Kumaravelu, G. 1979. **Clonal identification of *Tectona grandis* by isoenzyme studies**. Indian Forester 105(10): 716-719.

Four clones of teak were analysed biochemically for the esterase isoenzyme and the results indicate that it is possible to identify individual clones by this method.

0783 Lakshmikantham, D; Rawat, M.S; Kedharnath, S. 1974. **Half-sib analysis of genetic variance in teak**. Breeding researches in Asia and Oceania. Proceedings of the Second General Congress of the Society for the Advancement of Breeding Researches in Asia and Oceania. Session VII. Breeding of tropical tree species: 413-418. Indian Society of Genetics and Plant Breeding, New Delhi.

Heritability estimates for height in 16 half-sib families were 88, 85, 76 and 69 percent at 2, 4, 6 and 8 years, respectively, while those for stem girth were 88, 73, 74 and 53 percent respectively. Stem diameter and height were highly and positively correlated over the period. Prediction of family performance at 9 years was shown to be valid when based on correlation data of height and stem diameter with age at 6 years.

0784 Lane, D.A. 1970. **Reforestation and forest improvement in Thailand**. Vanasarn 28(3): 15-34.

The paper at the end contains the details of teak planted from 1910 to 1969. Early planting of teak were limited to only a few hundred acres which was increased as below with experience gained, 1951-53 (1000-1500 acres), 1954-60 (2000 to 5000 Acs.) and 1961-1969 (5000 to 20,000 acres). Totally during the period 1910-1969, 1,12,130 acres of teak is planted.

0785 Larsen, C.S. 1966. **Genetics in teak (*Tectona grandis* Linn.f.)**. Arsskrift Veterinary and Agriculture High School, Kobenhavn: 234-245.

Discusses work on teak breeding in Thailand, in particular the differences between two clones in the age of first flowering which determines the length of the straight unforked stem.

0786 Laurie, M.V. 1935. **Seed origin and its importance in Indian forestry**. Indian Forester 62(1): 18-22.

Investigation is made to know the effect of the teak seed origin on its growth.

0787 Laurie, M.V. 1939. **The importance of seed origin**. Proceedings of the 5th Silvicultural Conference, Dehra Dun, 1939, Item 4: 103-109. Forest Research Institute, Dehra Dun.

Details are given of the characteristics of 24 species of Indian trees including teak exhibiting individual and racial variations in the timber growth, form, hardness, yield of oil, resin or other minor products etc., many of these variations being of commercial importance.

0788 Laurie, M.V. 1939. **The importance of origin of seed in forestry**. Indian Forester 65(3): 145-150.

All India cooperative teak seed origin studies in progress aim at (i) seed germination (ii) rate of early growth (iii) volume production per acre (iv) timber form (v) suitability for growth in localities outside their natural range etc. The author suggests carrying out investigations (a) existence of figured wood and its inheritance (b) teak coloured wood (c) inheritance of fluting and (d) inheritance of relative frost hardness in some origins observed.

0789 Mandal, A.K; Chawhaan, P.H. 2003. **Investigations on inheritance of growth and wood properties and their interrelationships in teak**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

An investigation was undertaken to (i) assess the extent of genetic variation for growth and wood characters, (ii) estimate narrow sense heritability and genetic gain and (iii) identify best general combiners. Data on growth of height, dbh, basal area and wood specific gravity, sap wood and heart wood percent were collected and subjected to analysis of variance followed by estimation of genetic parameters. Results indicated that growth and wood characters are strongly inherited and most of the traits are under the influence of additive gene action indicating scope for improvement through selection and sexual reproduction.

0790 Mathews, J.D. 1961. **A progress of forest genetics and forest tree breeding research**. Report to the Government of India under FAO-Expanded Technical Assistance Program FAO-ETAP Report 1349.

A long term breeding programme for teak in India has been prepared, with suggestions for selection and breeding of teak under the heads, selection of plus trees and seed orchards, vegetative propagation, flowering, plant pollination, progeny testing, orchard for seed production and breeding system.

0791 Melchior, G.H. 1969. **The genetic improvement of tropical forest trees and its application to forest management**. (Spanish). Revista Forestal Venezolana 12(18): 23-51.

Reviews methods used in species and provenance trials, and gives some data from trials undertaken by the Forestry Institute of the University of Los Andes, Venezuela. *Pinus caribaea* and *Tectona grandis* are among species growing well on warm sites.

0792 Mooksombat, S. 1964. **Teak chromosome**. (Thai). Student Thesis. Kasetsart University, Bangkok.

A study of chromosomes from teak flower buds in diakinesis stage of macrosporophytes reported 18 pairs or 2n=36 chromosomes.

0793 Nagarajan, B; Gireesan, K; Venkatasubramanian, N; Shanthi, A; Sharma, R; Mandal, A.K. 1996. **An early evaluation of gene action in teak**. Myforest 32: 136-139.

0794 Prawotosoedarmo, S. 1957. **Investigation of races within species *Tectona grandis* Linn.f., in relation to decorative properties, growth etc. for breeding proposed in Indonesia.** 2nd Session of FAO Teak Sub-Commission, Bandung FAO/TSC-57/25: 3p. FAO, Rome.

Discusses various forms distinguished by timber or stem characters and views as to which of them may be considered true varieties, and recapitulate briefly on Coster and Eldmann's provenance trials. Javanese and Malabar teak appear to be superior in height, diameter growth and stem form.

0795 Rao, H.S. 1959. **Problems in Indian forest plant breeding**. Indian Forester 85(9): 515-527.

Many problems of forest plant breeding in India are discussed and different methods of genetic improvement programmes to be adopted are suggested. An inventory of mother trees for seed should be made all over the country for all species, and progenies raised from them and tested. Progenies of recorded `giant trees' should be raised to evaluate the genotype of these moribund old individuals. Important forest plant breeding problems of India include improvement of *Tectona grandis* and other species.

0796 Rawat, M.S. 1994. **Fruit/seed setting in teak (*Tectona grandis* Linn.f.): A point to ponder.** Indian Forester 120(12): 1076-1079.

The reasons for low seed production in teak are discussed, based on observations made from trees, progenies and grafts from 1926 to 1928 and from the seed orchard and the germplasm bank established as part of the teak improvement programme started in 1960 at the Forest Research Institute, Dehra Dun, Uttar Pradesh. The observations cover: flowering date and period; numbers and size of inflorescences; flower morphology; pollen development; fertilization; fruit production; germination, growth and winter survival of offspring; fruit setting and provenance performance.

0797 Richens, R.H. 1945. **Forest tree breeding and genetics**. Joint Publication Imperial Agricultural Bulletin, Burma 8: 79p.

This bulletin collates the more important papers on this subject that have appeared since 1930. General principles of tree breeding are described in an introductory section with a brief account of the basic theoretical concepts. The methods so far used include line breeding, the development of hybrids exhibiting heterosis, and the utilization of polyploids. The selection criteria that have been used by tree breeders include timber yield, photoperiodic adaptation, high reproductive capacity, tree shape, wood quality, competitive ability, and resistance to bacteria, fungi, insects, viruses, low temperature and other unfavourable environmental conditions. These characters are considered in general and with special reference to the tree genera include *Tectona grandis*. A glossary of the technical terms used in the bulletin and a bibliography of 605 references are appended.

0798 Singh, R.V; Gupta, G.C; Sharma, K.C. 1970. **Selection of Chil seed stands in Himachal Pradesh**. Proceedings of Seminar-cum-Workshop on Genetic Improvement Forest Tree Seed in India, Dehra Dun: 51-55.

0799 Soerianegara, I; Toda, R. 1974. **Forest tree improvement in Indonesia**. Forest tree Breeding in the World, Asia and Oceania: 146-153. Government Forest Experiment Station, Tokyo, Japan.

Six types of *Tectona grandis* are recognized, based on wood and stem characteristics. In provenance material trials, results after 25 years indicated that the best material for stem form and branching originated from Laos; for height from Malabar, Laos and from four sites in Indonesia; and for girth Malabar, Laos, Thailand and Indonesia. Details are given of FAO teak provenance trials laid down in 1959 at three Javanese sites.

0800 Swain, D; Mandal, A.K; Sharma, R. 1999. **Genetic analysis in teak (*Tectona grandis*)**. Journal of Tropical Forest Science 11(3): 582-586.

A genetic analysis of quantitative characters in teak was done using growth data from two progeny trials in Orissa. The seed used in the trial was from a clonal orchard composed of six clones selected from provenances from Orissa. The first trial was aged 8, and was established in 1986 with seed from 5 clones which flowered in 1984. The second trial was aged 7 years, and was established in 1987 with open pollinated seed from all 6 clones which flowered in 1985, so that 5 of the clones were common to both the trials. The results indicated the presence of considerable genetic variation for height, diameter and basal area. Moderately high to very high heritability and genetic gain values suggested the predominant role of additive gene action.

0801 Swain, D; Mohanty, S.C; Sharma, R; Mandal, A.K; Gupta, B.N. 1996. **Preliminary analysis of quantitative characters in teak**. Proceedings of the Indian National Science Academy. Part B Biological Sciences 62(2): 169-172.

The genetic architecture of quantitative characters in teak was studied in young trees raised from 27 half-sib families selected from phenotypically superior (plus trees) and established in a seed orchard in Orissa. By taking the growth measurements, it is found the presence of considerable genetic variation in the material. A preponderance of additive gene action was noticed for height, as evidenced by both high heritability and genetic gain values.

0802 Tewari, D.N. 1994. **Biodiversity and forest genetic resources**. 329p. International Book Distributors, Dehra Dun.

This book is a compilation of information on forest genetic resources and related biotechnological studies written with the aim of improving forest plantation productivity, sustainable forest management and conservation of biodiversity, with particular reference to India. It is covering information on international initiatives on genetic resource conservation with particular reference to tropical forests, the relations between conservation and tree breeding/tree improvement, and between genetic resources and forest management or plantation forestry, and the role and activities of international, national and regional organizations, seed technology, vegetative propagation by cuttings, tissue culture and provenance and tree improvement studies of major Indian species including *Tectona grandis*.

0803 Thorenaar, A. 1930. **Selection of teak - *Tectona grandis* Linn.f.** (Dutch). Tectona 23: 826-837.

0804 Venkatesh, C.S; Toda, R. 1974. **Forest tree improvement work in India: History, organization and present activities**. Forest tree Breeding in the World, Asia and Oceania: 137-145. Government Forest Experiment Station, Tokyo.

Following a brief account of the history of forest-tree breeding, information is provided on selection for height, trunk diameter and stem straightness, vegetative propagation techniques and resistance to *Hapalia machaeralis* and *Hyblaea puera* in *Tectona grandis*.

0805 White, K.J. 1962. **Tree breeding with teak (*Tectona grandis*)**. Australian Forestry 26(2): 90-93.

It is indicated that flowering is axillary and only apparently terminal because flowering usually puts an end to terminal growth. Examination of ca. 14,000 trees of 18 months old of which ca. 7.6 percent had flowered in 1961, revealed 26 trees in which vigorous terminal growth continued past the flower zone, i.e. 2.4 percent of the trees that flowered continued apical growth. Seed has been harvested from these trees, and if the characteristic of continued apical growth after flowering proves to be inherited, the teak breeder will have a valuable tool at his disposal.

0806 Wood, P.J. 1966. **Tree breeding work with teak in Tanzania**. Tanzania Silvicultural Research Note 1966.

The history of teak plantations in Tanzania is traced back to 1898 and provenance trials from India, Pakistan, Java, Trinidad, Sudan, Nigeria, Saigon, New Britain and Tanzania are described. Progeny tests of seed collected from open pollinated thirty eight seed trees are also described. Preliminary trials on grafting teak on one year old stocks is also tried.

0807 Wyatt Smith, J; Lowe, R.G. 1973. **Heritability of vigour in *Tectona grandis***. Federal Department of Forest Research, Nigeria, Research Paper Forest Series 11: 7p.

A comparison was made of the vigour of scions collected from (a) dominant trees, and (b) satellite sub-dominant trees, in a stand of 14-year-old *T. grandis*. The results show that Rohmeder's findings for temperate species in Germany are also applicable to *T. grandis*: heritability is not the major factor affecting growth, and the relative vigour of trees within an even-aged stand is determined mainly by environmental factors. Implications for tree breeding are discussed.

Go top

Plant Pollination

(See also 1412)

0808 Bhattacharya, A; Mandal, S. 1997. **Anthesis, pollen production and release of some angiospermic plant taxa**. Environment and Ecology 15(2): 283-287.

Anthesis, pollen production and pollen release were studied in ten species including *Tectona grandis* from West Bengal. The anther dehisced after anthesis in *T. grandis*.

0809 Bhattacharya, A; Mandal, S. 2000. **A contribution to the diversity of insects with reference to pollination mechanism in some angiosperms**. Biodiversity and environment. Proceedings of the National Seminar on Environmental Biology, Visva Bharati University, Santiniketan, India, 3-5 April 1998: 197-204. A.K. Aditya; P. Haldar, Eds. Daya Publishing House, Delhi.

Pollination is an important phenomenon for gene recombination as a result of which genetic and species diversity is promoted. Regular observation on the pollination mechanism of five angiosperm plants including *Tectona grandis* revealed that different members of Thysanoptera, Hymenoptera, Lepidoptera, etc. visited flowers and enhanced pollinating potential.

0810 Bhumibhamon, S; Atipanumpai, L; Kanchanarangsri, S. 1981. **Fruit production in teak seed orchards**. IUFRO XVII World Congress, Kyoto, Japan.

The study investigated fruit production in a ten year old teak seed orchard in Thailand; variation in the age of flowering was attributed to genetic control and it was indicated that teak ramets required fourteen years to reach flowering/fruiting maturity. Most clones showed more small fruits than medium and big ones in the ratio 46:36:18 respectively. Further studies on pollination and silvicultural practices to improve fruit size and quality were noted.

0811 Bryndum, K; Hedegart, T. 1969. **Pollination of teak (*Tectona grandis* Linn.f.)**. Silvae Genetica 18(3): 77-80.

Reports observations at the Thai-Danish Teak Improvement Centre, Thailand on flowering in teak, and the results of experiments in controlled pollination. Emasculation and isolation is carried out. It is reported that the early afternoon is the best time for pollination. Insects are the chief natural pollinators. Teak is mainly a cross-pollinating species, though it will fruit after selfing.

0812 Cameron, A.L. 1968. **Forest tree improvement in New Guinea. I. teak**. Proceedings of the 9th Commonwealth Forestry Conference, New Delhi, 1968: 8p.

The author discusses teak pollination.

0813 Egenti, L.C. 1975. **Preliminary studies on pollinators of teak (*Tectona grandis* Linn.f.)**. Forest Series, Federal Department of Forest Research, Nigeria, Research Paper 29: 7p.

Six main species responsible for pollination were identified, including 3 species of Nymphalidae, and Nomia spp. These insects were not present outside the flowering period.

0814 Egenti, L.C. 1978. **Pollen and stigma viability in teak (*Tectona grandis* Linn.f.)**. Silvae Genetica 27(1): 29-32.

In pollination tests in plantations near Ibadan, Nigeria, the highest percentage fruit set was obtained with pollen used on the day of anthesis. In vitro tests showed 14 percent sucrose to be the most favourable medium for pollen germination. The percentage of germination was not reduced after storage of pollen for thirty five days in a vacum desiccator.

0815 Gunaga, R; Vasudeva, R. 2002. **Variation in flowering phenology in a clonal seed orchard of teak (*Tectona grandis* Linn.f.)**. Journal of Tree Science 21(1/2): 1-10.

A nineteen year old clonal seed orchard of teak showed a large variation in flowering phenology among twenty four clones. Flowering was asynchronous with two distinct episodic peaks of flowering initiation of May to July and July to August. Provenance effect on flowering phenology was observed. Various flowering phenophases showed high heritability on individual tree.

0816 Hedegart, T. 1973. **Pollination of teak (*Tectona grandis* Linn.f.)**. Silvae Genetica 22(4): 124-128.

Natural pollination of teak is effected mainly by insects, in particular by two species of Apidae. The fertilization percentage after natural pollination was generally low, and this is ascribed to an insufficient number of pollinating insects. Success of controlled cross-pollination by hand was much greater, and it is suggested that with large-scale crossing studies, the very slow procedure for controlled pollination should be drastically simplified by omission of emasculation and isolation.

0817 Indira, E.P; Mohanadas, K. 2002. **Intrinsic and extrinsic factors affecting pollination and fruit productivity in teak (*Tectona grandis* Linn.f.)**. Indian Journal of Genetics and Plant Breeding 62(3): 208-214.

Though clonal seed orchard establishment has progressed very well in the country, low fruit productivity has hampered the teak improvement programmes to a great extent. The field studies as well as laboratory experiments led to the conclusions that inadequate pollinator activity, low pollen-ovule ratio, self-incompatibility and fruit abortion due to dominance effect of floral initiation and fungal infection are the main causes for low fruit productivity in teak.

0818 Kjaer, E.D; Suangtho, V. 1995. **Outcrossing rate of teak (*Tectona grandis* (L.))**. Silvae Genetica 44(4): 175-177.

The outcrossing rate of *T. grandis* was estimated by determining the allozyme variation at 4 loci in progenies from 15 trees collected near Ngao, Thailand. The results suggested that teak is mainly an outcrossing species, which is in agreement with results from controlled pollinations.

0819 Mathew, G; Koshy, M.P; Mohanadas, K. 1987. **Preliminary studies on insect visitors to teak (*Tectona grandis* Linn.f.) inflorescence in Kerala, India**. Indian Forester 113(1): 61-64.

Preliminary results showed that insect activity was greater during the cooler morning hours. Seventeen species were identified, 13 from the order Hymenoptera, 2 Diptera and 2 Lepidoptera. The hymenopterans were the most frequent visitors, especially the solitary bees *Prosopis pratensis*, *Allodope marginata* and *Halictus* sp. It is suggested that the possibility of enhancing pollination with domestic bee species be investigated.

0820 Mohanadas, K; Mathew, G; Indira, E.P. 2002. **Pollination ecology of teak in Kerala**. KFRI Research Report 225: 36p. Kerala Forest Research Institute, Peechi.

An investigation was undertaken to study the breeding system and various aspects of pollination in teak. In Kerala, flowering of teak trees generally coincides with the South-West monsoon. On an average, each tree bears more than 300 inflorescence. The number of flowers in an inflorescence varies from 5000 to 7000 and it takes 30-40 days for the flowering to complete a single inflorescence. Studies show that teak prefers cross-pollination although a certain amount of selfing could also be observed. Insects were found to play a major role in pollination. The insects observed on the teak inflorescence were also identified. Factors leading to premature fruit fall was also investigated and a fungus *Phomopsis* sp. was also found to be the major cause.

0821 Narendran, T.C; Jobiraj, T; Mohandas, K. 2000. **A remarkable new species of the bee genus *Halictus* Latreille (Hymenoptera: Apoidea: Halictidae) from India**. Journal of Advanced Zoology 21(1): 48-50.

Halictus tectonae sp. nov., a pollinator of teak flowers in Kerala, India, is reported.

0822 Palupi, E.R; Owens, J.N. 1997. **Pollination, fertilization, and embryogenesis of teak (*Tectona grandis* Linn.f.)**. International Journal of Plant Sciences 158(3): 259-273.

Three clones representing low, intermediate, and high fruit-production capacity in teak were selected from a clonal seed orchard in East Java, Indonesia. Low fruit and seed set were the major constraints in fruit production. Most teak pollen germinated and pollen tubes reached the ovary or micropyle 24 h AFO. Some abnormalities in pollen-tube growth were observed. The major cause of fruit abortion is abnormal development of the endosperm.

0823 Sasidharan, K.R; Nagarajan, B; Nicodemus, A; Mahadevan, N.P; Durai, A; Gireesan, K; Varghese, M. 1999. **Insect pollination versus enhanced fruit production in *Tamarindus indica* and *Tectona grandis***. Journal of Palynology 35/36: 93-97.

Experiments were conducted to investigate the floral biology, flower visitors and fruiting aspects of *Tamarindus indica* and *Tectona grandis* from Coimbatore, Tamil Nadu. The functional aspects of flowers in relation to the foraging activity and probing behaviour of flower-visitors were observed. Teak flowers were foraged during day time by insects belonging to orders Diptera, Hymenoptera, Lepidoptera, Coleoptera and Hemiptera.

0824 Subramanian, K; Seethalakshmi, T.S. 1984. **A preliminary note on pollen in teak in relation to fruit-set**. Indian Forester 110(10): 1023-1029.

A study was made of pollen grains of teak from Chanda, Chikhalda, Nagpur, Sawantwadi and Pune, Maharashtra, in an attempt to correlate sterility in pollen grains with poor fruit set. The percentage of sterility is found insignificant, it was concluded that pollen sterility as a major factor for poor seed set can be ruled out. Investigations on pollen viability and stigmatic receptivity are suggested.

0825 Tangmitcharoen, S. 1997. **Controlled hand-pollination of teak**. Teaknet Newsletter 7: 4-6.

This is an extract from 'A manual on techniques for controlled hand-pollination of teak. The manual is based on tree breeding studies by Thailand's Royal Forest Department, and a literature review. The extract gives brief details of procedures to be used.

0826 Tangmitcharoen, S; Owens, J.N. 1996. **Floral biology, pollination and pollen-tube growth in relation to low fruit production of teak (*Tectona grandis* Linn.f.) in Thailand**. Tree improvement for sustainable tropical forestry. QFRI IUFRO Conference, Queensland, Australia, 27 October-1 November 1996. Volume 1: 265-270. M.J. Dieters; A.C. Matheson; D.G. Nikles; C.E. Harwood; S.M. Walker, Eds. Queensland Forestry Research Institute, Australia.

Teak flowers are weakly protandrous. The papillate stigma is of the wet type with a hollow style and a short receptive period. The major pollinators are *Ceratina* spp. The main cause for low fruit set in teak is lack of insect pollinators and their effectiveness. Although 78 percent of flowers are pollinated in open pollination, there is a high rate of selfing. Late-acting gametophytic self-incompatibility, or post-zygotic abortion probably are the causes of high early fruit abortion.

0827 Tangmitcharoen, S; Owens, J.N. 1997. **Floral biology, pollination, pistil receptivity, and pollen tube growth of teak (*Tectona grandis* Linn.f.)**. Annals of Botany 79(3): 227-241.

An account is given of floral morphology, pollen shedding and structure, stigma development and receptivity, insect visitors to flowers, the pathway of pollen tube growth to the embryo sac and rate of pollen tube growth, and pollination success and the pollen-ovule ratio.

0828 Tangmitcharoen, S; Owens, J.N. 1997. **Pollen viability and pollen-tube growth following controlled pollination and their relation to low fruit production in teak (*Tectona grandis* Linn.f.)**. Annals of Botany 80(4): 401-410.

Results are discussed of pollen viability and longevity, the patterns and rates of in vitro and in vivo pollen-tube growth following controlled pollinations, various abnormalities observed in *in vivo* pollen-tube growth, rate and form of self-incompatibility, reproductive success, fruit set and rate of fruit abortion.

0829 Thangaraja, A; Senthilkumar, N; Ganesan, V. 2001. **Foraging dynamics of floral visitors of *Tectona grandis* Linn.f. (Verbenaceae)**. Insect Environment 7(3): 133-134.

It is found that a total of nine flower visitors, Graphium sarpedon choredon, Papilio polymnestor, Apis cerana indica, Apis mellifera, Oecophylla smaragdina, Musca domestica, Tabanus atratus, Mylabris pustulata and Xylocopa sp. were observed, 5 of them were found to be nectar and pollen foragers. In teak flowers, the diurnal activity of flies began at 06.00 h, which became normal up to 09.00 h. There was a declining trend in foraging activity up to 12.00 h, which became normal up to 11.00 h.

0830 Vasudeva, R; Gunaga, R; Hanumantha, M. 2000. **Non-synchronous flowering in teak seed orchards - a cause for low fruit production**. National Symposium on Forestry towards 21st Century, Tamil Nadu. Agricultural University, Coimbatore.

0831 Zeya, A. 1982. **Detrimental effects of some insects on teak fruit yield**. Research Leaflet 14. Forest Research Institute, Burma.

Reduction in teak fruit production and possible reduction in teak seed germination rates due to insects were investigated. Methods for protection and control of insects having detrimental effects on production of viable fruits in seed orchards are proposed.

Go top

Genetic Improvement

(See also 0812, 1422, 3105, 3413, 4011, 4485, 4489)

0832 **Teak Improvement Centre**. Progress Report 6, 1967: 13p. Teak Improvement Centre, Ngao.

Reported the activities of the centre during the last 6 months which includes mainly establishment of seed orchards by budding, provenance trials and selection of seed source areas. The research projects include pollination studies and developing techniques and methods of isolation and controlled pollination and comparison of results with self pollination and wind pollinations.

0833 **Teak Improvement Centre**. Progress Report 7, 1967: 12p. Teak Improvement Centre, Ngao.

Reported the activities of the centre of six months upto July 1967. Improvement programme under taken includes selection of plus trees, establishment of seed orchards and enlarging their areas, budding research for vegetative propagation and provenance trials. The research studies cover budding techniques and time of budding, seed and nursery investigations, fertilizer effects, controlled pollinations and grading and splitting of stumps.

0834 **Teak Improvement Centre**. Progress Report 8, 1968: 12p. Teak Improvement Centre, Ngao.

Reported the work carried out by TIC during the period of six months upto January 1968. The improvement programme includes extension of clone collections, establishment of seed orchards and carrying out provenance trials. The research programmes cover, both vegetative and generative propagation studies, mainly on budding techniques, seasons and storing budwood and use of graded stumps, split stumps etc. and 1700 controlled pollinations were made with 12 percent. Success in fruit formation and 55 saplings after isolation were also carried out.

0835 **Teak Improvement Centre**. Progress Report 11, 1968: 9p. Teak Improvement Centre, Ngao.

Progress report of the work done during the period of six months upto July 1968. The teak improvement programmes were plus tree selection, clonal collections, seed orchards, establishment and provenance trials and research programmes include autumn budding and green budding trials, spacing trial in plantations, grading of stumps, continuation of pollination studies, and mechanization of nursery work.

0836 **Teak Improvement Centre**. Progress Report 12, 1969: 9p. Teak Improvement Centre, Ngao.

A report of DANIDA on progress made by the centre in clone collection, seed orchards, provenance tests etc.

0837 **Teak Improvement Centre**. Progress Report 13, 1969: 3p. Teak Improvement Centre, Ngao.

Reported the activities of TIC for the period of six months upto July 1969. The improvement programme includes plus trees selection, seed orchard work and provenance testing. Research programmes cover, use of potted stumps for budding, rooting, cuttings, sowing rate, machine treatment of seed and use of cover crop in Mae-Gar seed orchard.

0838 **Teak Improvement Centre**. Progress Report 14, 1970: 17p. Teak Improvement Centre, Ngao.

Reported the activities of the TIC during the period of six months upto January 1970. The activities reported include provenance research (testing of earlier field trials, collection and processing of data), breeding (studies on natural pollination and comparison with controlled hand pollination), seed orchard work, clone collections and extension of multiplication gardens), silviculture and nursery research includes tending, collection and processing of data and training programme.

0839 **Teak Improvement Centre**. Progress Report 15, 1970: 14p. Teak Improvement Centre, Ngao.

The report includes the activities of provenance research, breeding research, seed orchards, silvicultural research and nursery research and training counterparts.

0840 **Teak Improvement Centre**. Progress Report 18, 1971: 15p. Teak Improvement Centre, Ngao.

Six months report of the various activities of TIC upto January 1971 under the headings, provenance research, breeding, silviculture, nursery, tending and miscellaneous items.

0841 **Teak Improvement Centre**. Progress Report 21, 1971: 9p. Teak Improvement Centre, Ngao.

Reported the activities of TIC for the period of six months upto July 1971 under the heading provenance research, breeding (selection of plus trees in plantations and seed orchard work), silviculture (pruning experiments, spacing trials, weeding trials, seed production in relation to site class and stand age, optimum stump size for transplanting) and nursery research (early pulling and storing of stumps, long term (0-5 years) seed storage results. Optimum sowing time, and time and method of fertilizer application. Production of potted root stocks and root growth and training and miscellaneous items.

0842 **Teak Improvement Centre in Thailand - Description and Evaluation**. Report by Mr.H. Keiding to DANIDA in 1971 on the evaluation of TIC since 1965 to date, 1971: 17p. Teak Improvement Centre, Ngao.

An evaluation report since the starting of the TIC in 1965, giving the background history and reviewing the achievements and impacts of TIC on Tai Forestry service and forest industry organizations. The results include provision of material for breeding, organization of seed collection, distribution and utilization, coordination with other fields of forestry and forest organizations, training and silvicultural research.

0843 **Teak Improvement Centre**. Progress Report 22, 1972: 15p. Teak Improvement Centre, Ngao.

Reported the activities of TIC for the period of six months upto January 1972 under the items provenance research, breeding, silvicultural research, nursery research and training of counterparts.

0844**Teak Improvement Centre**. Progress Report 23, 1972: 11p. Teak Improvement Centre, Ngao.

The report covers the activities of TIC for six months upto July 1972 in the fields of (1) provenance trials (nursery and field trials) (2) breeding work (seed orchards) management of seed source areas, clonal collections, pollination and stump budding and grafting investigations; (3) silviculturalsection (deals with spacing trials, weeding trials, pruning studies, and (4) nursery section (stump storage equipment, seed storage and studies on the influence of collection time on germination.

0845 **Teak Improvement Centre**. Progress Report 24, 1973: 23p. Teak Improvement Centre, Ngao.

The annual report of the activities of TIC which include seed orchard work, seed source areas, clone collections, pollinations, investigations, stump, budding, and multiplication garden work, spacing and weeding trials, pruning and thinning studies, and nursery investigations cover studies on seed quality, stand age and site quality, standard testing of teak seed, seed storage, and use of fertilizers, storage of stumps and seedlings etc.

0846 Ansari, A.A; Shrivastava, R.K; Anjana Rajput. 2002. **A report on new hybrid SFRI JBP/1 & SFRI JBP/2 of teak**. Vaniki Sandesh 26(3/4): 31-33.

This paper discusses the production of two new hybrids of teak achieved through controlled crossing.

0847 Apichart Kaosa ard. 1989. **Teak improvement strategy in Thailand**. Breeding Tropical Trees: Population structure and genetic improvement strategies in clonal and seedling forestry. Proceedings of the IUFRO Conference, Thailand, November 1998: 250-258. Oxford Forestry Institute, Oxford and Winrock International, Virginia.

Teak improvement programme in Thailand has been set up for more than two decades. One of the remarkable features of this programme is the possibility to create superior clones for mass clonal propagation by means of tissue culture techniques for the clonal planting programme. The breeding methods are described in this paper.

0848 Apichart Kaosa ard. 1992. **Teak international provenance trial I: Growth and stem quality**. Proceedings of the Seminar on 50 Anniversary of Huay-Tak Teak plantation, Bangkok, 5-8 August 1992.

14 year-old teak provenance trial, established inside the Mae Huad plantation was assessed and evaluated for their growth, stem quality and health performance. The trial consist of 8 provenances, Indonesia, India and Thailand. The study showed that Thai and Indonesian provenances performed much better, in terms of growth and stem quality and the Thai provenance was the most superior provenance among the tested provenances.

0849 Apichart Kaosa ard. 1992. **Teak international provenance trial II: Wood production and qualities**. Proceedings of the Seminar on 50 Anniversary of Huay-Tak Teak plantation, Bangkok, 5-8 August 1992.

Two international teak provenance trials were assessed for wood production and wood properties in 1991.

0850 Apichart Kaosa ard. 1998. **Teak breeding and improvement strategies**. Teak for the Future, Proceedings of the 2nd Regional Seminar on Teak, Yangon, Indonesia, 29 May-3 June 1995: 41-81.

0851 Apichart Kaosa ard. 2000. **Gains from provenance selection**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 191-208. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

The paper reviews provenance variation expressed in genotypic values at local and international levels and provenance x region matching.

0852 Apichart Kaosa ard; Suangtho, V; Kjaer, E.D. 1998. **Experience from tree improvement of teak (*Tectona grandis*) in Thailand**. Danida Forest Seed Centre Technical Note 50. Danida Forest Seed Centre, Denmark.

Tree improvement activities are initiated in the country in order to obtain gains in selected characters. The large differences in growth conditions within the natural range of teak indicate the existence of genetic differences between origins. Discussed the teak improvement activities in Thailand which include selection of plus trees and establishment of clonal seed orchards, seed production areas and development of vegetative propagation techniques.

0853 Apichart Kaosa ard; Suangtho, V; Kjaer, E.D. 1998. **Genetic improvement of teak (*Tectona grandis*) in Thailand**. Forest Genetic Resources 26: 21-29.

Teak breeding in Thailand is discussed by considering seed requirements, genetic variation and genetic gain. Improvement activities undertaken in Thailand are described, including the selection of plus trees and establishment of clonal seed orchards, seed production area, and development of vegetative propagation techniques. Information is provided on the conservation of genetic resources, both *in situ* and *ex situ*, and lessons that can be learnt for future breeding programmes.

0854 Aung, M.M. 2002. **State of forests and forest genetic resources in Myanmar**. Proceedings of the Southeast Asian moving workshop on conservation, management and utilization of forest genetic resources, Thailand, 25 February - 10 March 2001. J. Koskela; S. Appanah; A.P. Pedersen; M.D. Markopoulos, Eds. FORSPA Publication 31: 65-74. FAO Regional Office for Asia and the Pacific, Bangkok, Thailand.

The status of forests and forest genetic resources in Myanmar was assessed based on forest cover, number of plant species, forest types by area and vegetation type, wood volume by vegetation type, and the permanent forest estate data. Forest resources utilization and management are discussed. A special teak plantation programme in the country is discussed.

0855 Bagchi, S.K. 1995. **Selection differential and predicted genetic gain in *Tectona grandis***. Indian Forester 121(6): 482-490.

In a study of selected plus trees and comparison trees of teak at 80 locations in Karnataka, Tamil Nadu and Kerala, selection differential and predicted genetic gain values were estimated. This involved individual character variation analysis, estimation of heritability and computation of predicted gain values. Predicted gain values were estimated for individual batches along with an overall estimate.

0856 Bagchi, S.K. 1998. **Differential response in parameters due to location of planting sites in *Tectona grandis*. I. Mean and critical difference**. Indian Journal of Tropical Biodiversity 3/6(1/4): 27-34.

A study was conducted to assess the area wise variability of different groups of phenotypically superior teak plants from southern India showing within group and between group variations in five characters. It was concluded that selection and mass vegetative propagation producing large number of plantlets for the purposes of raising plantation may result in higher productivity.

0857 Bagchi, S.K. 2000. **Differential response in parameters due to location of planting sites in *Tectona grandis*-II. Analysis of variance**. Indian Journal of Forestry 23(1): 57-60.

A statistical analysis is made of growth data from a tree improvement programme for *Tectona grandis* in different forest divisions in three states of Tamil Nadu, Kerala and Karnataka. Growth measurements made included total height, clear bole length, diameter at breast height and crown length. It was reported that there were significant growth differences among and within forest divisions. It is also indicated significant differences is not only in between batch components, but also within batch components. This shows the presence of an additive variance component that can be exploited through stringent selection.

0858 Balasubramanian, R; Kumaravelu, G. 1981. **Isoenzymes of leaf peroxidases to distinguish clones of *Tectona grandis***. Indian Journal of Forestry 4(4): 258-260.

Polyacrylamide disc gel electrophoresis studies showed differences in leaf peroxidases between plus trees and a check tree.

0859 Beard, J.S. 1943. **The importance of race in teak, *Tectona grandis* Linn.f.** Caribbean Forester 4: 135-139.

Teak has been raised in Trinidad from seed imported both from Southern India and Burma, seed from the latter source giving much the better growth under the prevailing conditions.

0860 Bhat, K.M; Indira, E.P. 1997. **Specific gravity as selection criterion of genetic improvement of teak wood quality: Tree breeder's perspective**. Timber management toward wood quality and end product value. Proceedings of the CTIA IUFRO International Wood Quality Workshop, Quebec City, Canada, 18-22 August 1997: IV.91-IV.96. S.Y. Zhang; R. Gosselin; G. Chauret, Eds. Forintek Canada Corporation, Canada.

The study examines the scope for choosing wood specific gravity as the selection criterion of overall genetic improvement of timber strength of teak - a ring-porous tropical hardwood.

0861 Bingchao, K. 1996. **Evaluation on aggregate genetic value of main characters of provenances of teak**. Forest Research, China 9(1): 7-14.

0862 Boonkird, S. 1954. **Progress report on the first teak-tree show in Thailand**. Natural History Bulletin of the Siam Society 20(4): 243-256.

Gives an account of the work done by the Thai-Danish Teak Improvement Centre and discuss the importance of tree in tree breeding programmes.

0863 Boontawee, B; Apichart Kaosa ard; Piyapan, P. 1992. **Teak seed orchards in Thailand**. Proceedings of the Seminar on 50 Anniversary of Huay-Tak Teak plantation, Bangkok, 5-8 August 1992.

0864 Bor, N.L. 1939. **Summary of the results to date of the All India co-operative teak seed origin investigation**. Proceedings of 5th Silvicultural Conference, Dehra Dun: p115.

Lists, leaf variations, characteristics and descriptions of ten origins of teak in size, colour, texture etc. and a key was compiled and presented for their identification.

0865 Britwum, S.P.K. 1978. **Species and provenance selection of tropical hardwood species with special reference to West Africa**. World Consultation on Forest Tree Breeding, 3rd, Canberra, Australia, 21-26 March 1977. v.1: 143-154. CSIRO, Australia.

This paper presents the efforts made in provenance studies of tropical hardwood species and emphasizes the need for centralised co-operation programmes on regional levels for seed collection and provenance studies of indigenous species. Provenance trials of exotic species *Tectona grandis* which have been established on national level through international co-operation have also been discussed.

0866 Burley, J; Kemp, R.H. 1973. **Centralised planning and international co-operation in the introduction and improvement of tropical tree species**. Commonwealth Forestry Review 52(4): 335-343.

Discusses the value of centralized planning of tree-breeding work, with examples of several existing co-operative programmes including the activities of FAO and IUFRO and of three centres, the Commonwealth Forestry Institute, Oxford, the Danish seed centre and Pine and Teak centres in Thailand and the Forest Research Institute, Canberra and the Philippines).

0867 Cameron, A.L. 1966. **Genetic improvement of teak in New Guinea**. Australian Forestry 30(1): 76-87.

The programme involves provenance testing, individual tree selection, seed-orchard establishment, clonal and progeny testing, and studies on heritability. Two 10-acre clonal seed orchards have been established.

0868 Chadhar, S.K. 1994. **Preliminary performance of some provenances of teak in Seoni District of Madhya Pradesh**. Vaniki Sandesh 18(4): 28-31.

Ten-year performance data are given for 8 Indian provenances of teak.

0869 Changtragoon, S; Szmidt, A.E. 2000. **Genetic diversity of teak (*Tectona grandis* Linn.f.) in Thailand revealed by random amplified polymorphic DNA markers**. IUFRO Conference on Tropical Species Breeding and Genetic Resources: Forest Genetics for the next Millennium, Durban, South Africa, 8-13 October 2000: 82-83.

0870 Chaudhari, N.R. 1970. **Experience with raising of teak seed orchard in Maharashtra state**. Proceedings of the Seminar cum Workshop on General Improvement of Forest Tree Seed in India, Dehra Dun: 56-67.

The paper describes experience gained in starting a teak orchard in Maharashtra state. The works involves discovery of superior trees of teak, bud grafting, preparation of site for orchard, planting of grafts and their care. In the end gives percentage success of but grafts made in different months and percentage success of bud grafts made by different individuals.

0871 Chawhaan, P.H; Khobragade, N.D; Mandal, A.K. 2003. **Genetic analysis of fruit and seed parameters in teak (*Tectona grandis* Linn.f.): Implications in seed production programme**. Indian Journal of Genetics and Plant Breeding 63(3): 239-242.

Genetic analysis of fruit and seed parameters in teak was conducted using open-pollinated fruits from more than 40 trees of Madhya Pradesh. The results indicated highly significant variation for all the characters studied. Implications of the present findings in seed production programme of teak have been discussed.

0872 Chawhaan, P.H; Mandal, A.K. 2003. **Impact of genetically improved seeds in enhance-**

ment of productivity of plantations: A case study of teak. TEAKNET 31: 1-4.

Considering the magnitude of genetic diversity and commercial value of the species, teak improvement work in India was initiated during early sixties. These activities resulted in selection of phenotypically superior trees, establishment of seed production populations and breeding populations. Here reports the impact of use of improved seed in increasing the volume production of teak plantations.

0873 Commonwealth Forestry Institute, Oxford. 1978. **Progress and problems of genetic improvement of tropical forest trees. Proceedings of a joint workshop, IUFRO working parties S2.02-08 and S2.03-01, Brisbane, 1977. V. Provenance trials and breeding programmes. F. *Tectona grandis* Linn.f: 730-807. D.G. Nikles; J. Burley; R.D. Barnes, Eds**. Commonwealth Forestry Institute, Oxford, UK.

Reports are given on international trials in Ivory Coast, Nigeria, Andhra Pradesh, Upper Volta, Sri Lanka, and Jari, Para, Brazil. A review of contributions is included.

0874 Commonwealth Forestry Institute, Oxford. 1984. **Provenance and genetic improvement strategies in tropical forest trees. Proceedings of a joint conference of IUFRO S2.02 08, S2.03-01, S2.03-13, Mutare, Zimbabwe, 9-14 April 1984: 1-148**. Commonwealth Forestry Institute, Oxford.

Following papers are included: 1. Inbreeding, hybridization and conservation in provenances of tropical forest trees, 2. Evaluation of a series of teak and gmelina provenance trials - selection of traits, their assessment and analysis of observations, 3. Design, management and assessment of species, provenance and breeding trials of multipurpose trees, 4. Provenance X environment interaction; its detection, practical importance and use with particular reference to tropical forestry, 5. Strategies for the incorporation of new provenance material in existing breeding populations of tropical forest trees, 6. Influence of propagation by cuttings on the breeding strategy of forest trees.

0875 Connelly, S. 1990. **Final assessment of teak provenance trial at Wanniyagama**. Sri Lanka Forester 19(3/4): 69-70.

Preliminary results of the provenance trial of teak conducted in Sri Lanka are presented.

0876 Dabral, S.L; Wadeturer, R.N. 1977. **A concise field manual on raising teak seed orchard**. MVSS Forest Records 1.

0877 Davidson, J; Howcroft, N.H.S. 1973 . **Papua New Guinea tree improvement and introduction progress report 1972**. Papua New Guinea, Tropical Forestry Research Note SR.1: 15p.

A report prepared for the meeting of Research Working Group No. 1 of the Research Committee of the Australian Forestry Council on Tree Improvement and Introduction, Mt. Gambier, S. Australia, November 1972. It summarizes improvement work done up to 1972 on different species including *Tectona grandis*.

0878 Delaunay, J. 1977. **Results of *Tectona grandis* Linn.f. provenance trials six years after initiation in Ivory Coast**. Proceedings of the Joint IUFRO Workshop, Brisbane Vol.2: 734-742.

0879 Delaunay, J. 1978. **Results of provenance trials with teak, *Tectona grandis*, six years after planting in Ivory Coast**. (French). World Consultation on Forest Tree Breeding, Canberra, Australia, 3rd, 21-26 March 1977. v.1: 273-284.

Seeds collected from India, Thailand, West Africa and Tanzania plantations of the species *Tectona grandis* were used to lay out a provenance trial in Ivory Coast. Assessments on vigor, quality of boles and flowering have been statistically analysed.

0880 Devar, T.A.M. 1970. **Forest tree improvement programme in Tamil Nadu**. Proceedings of the Seminar-cum-Workshop on General Improvement of Forest Tree Seeds in India: 36-45. FRI, Dehra Dun.

Describes seed orchard and teak seed origin experiments in the state from 1932 onwards for teak along with wattle, cashew, eucalypt and sandal.

0881 Egenti, L.C. 1977. **Observations on vigour and form of teak (*Tectona grandis* Linn.f.) from local and international provenances in Nigeria**. Obeche 13: 53-69.

Provenance trials were set up in 3 sites: Akilla (rain-forest), Ibadan (moist semi-deciduous forest) and Olokemeji (mixed deciduous forest and derived savanna). It is found that the survival and growth were best at Akilla, although the other sites had twice as many straight-stemmed trees.

0882 Egenti, L.C. 1977. **The international provenance trials of teak (*Tectona grandis* Linn.f.) in Nigeria**. Proceedings of the Joint IUFRO Workshop, Brisbane Vol.2: 754-760.

0883 Egenti, L.C. 1978. **The Danish/FAO international provenance trials of *Tectona grandis* in Nigeria**. Indian Forester 104(4): 227-237.

One-year-old seedlings of 20 provenances of *T. grandis* were planted out at six sites in Nigeria. Significant differences between locations are indicated for height, girth, stem form and crown and branching. The provenances are also ranked with respect to these parameters for each site. Data on survival, fox-tailing and fruiting are tabulated.

0884 Emmanuel, C.J.S.K. 2000. **Genetical improvement of teak: Concept, application and achievement**. Genetics and Silviculture of Teak. A.K. Mandal; S.A. Ansari, Eds. International Book Distributors, Dehra Dun.

0885 Emmanuel, C.J.S.K; Kapoor, M.L; Sharma, V.K. 1992. **Three decades of forest genetics and tree improvement**. Indian Forester 118(7): 489-500.

An account is given of work carried out on the genetics and improvement of important tree species including teak by the Forest Research Institute at Dehra Dun and its sister organizations, under various projects/schemes. The use of vegetative propagation techniques in the work is also described.

0886 FAO. 1972. **Provenance collections of teak**. Forest Genetic Resources Information 2: 54-61. Rome, FAO.

Tabulated data are presented on the provenance of stored seed samples from numerous sites in 15 countries.

0887 Forest Department, Papua and New Guinea. 1962. **Genetic improvement of teak: (a) Flowering observations; (b) seed production studies**. Report of Department of Forestry, Papua and New Guinea 1962/63: 34-36.

Age of first flowering and frequency of flowering have been noted in a teak stand. One-third of the trees had flowered by the age of three years, and about one-half by 3 1/2 years, and once flowering has started it usually occurs annually. Ultimate log length has been fixed by the first flowering.

0888 Forest Tree Improvement, Arboretet Hoersholm. 1972. **Symposium on seed orchards in honour of C. Syrach-Larsen**. Forest Tree Improvement, Arboretet Hoersholm 4: 135p.

The following papers on seed orchards related to forest trees are included. 1. Seed orchards in forestry, 2. Biological and technical problems in American seed orchard development, 3. Nature's diversifying selection and its impacts on orchard breeding, 4. Certification and classification of seed orchards, 5. Seed orchards in relation to silviculture, 6. Seed orchards of hevea and teak with special reference to teak seed orchards in Thailand, 7. Seed orchard work of the Danish Health Society.

0889 Gera, M; Gera, N; Sharma, S. 2001. **Estimation of variability in growth characters of forty clones of *Tectona grandis* Linn.f.** Indian Forester 127(6): 639-644.

A study was conducted in Jabalpur, Madhya Pradesh to assess the genetic variability of teak with respect to growth characters and survival percentage and the degree of their transmission to progeny. Plant height and collar diameter gave comparable values for genotypic and phenotypic variations and coefficients of variation, indicating that these parameters are under genetic control.

0890 Gogate, M.G. 1993. **Tree improvement in Maharashtra with special reference to *Tectona grandis***. Proceedings of Workshop on Production of Genetically Improved Planting Material for Afforestation Programmes, Philippines: 16-36. K. Vivekananda; K.N. Subramanian; N.Q. Zabala; K. Gurumurti, Eds.

0891 Gogate, M.G; Gujar, D; Mandal, A.K; Sharma, R; Gupta, B.N; Lal, R.B. 1998. **Genetic analysis of quantitative characters in teak (*Tectona grandis*)**. Indian Journal of Tropical Biodiversity 3/6(1/4): 41-45.

Genetic analysis of quantitative characters in teak was made using six year growth data from a progeny test materials established with eighteen clones. The analysis revealed non-additive gene action for height and additive gene action for diameter and basal area. Moderate to moderately high estimates of heritability and genetic gain were obtained for diameter and basal area including highly significant genetic correlation for these two traits. Results have been discussed in the light of breeding strategies to be followed in teak.

0892 Goh, D.K.S; Alloysius, D; Gidiman, J; Chan, H.H; Mallet, B; Monteuuis, O. 2003. **Selection and propagation of superior teak plant material for improved quality plantation establishment: The ICSB/Cirad-forests joint project as a case study**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Materials from mature selected plus trees from a broad genetic base and seeds of presumed high genetic value but in restricted number were multiplied by using a well developed tissue culture technique at the Plant Biotechnology Laboratory. Seed lots from natural forest stands, plantations and a multi-provenance clonal seed orchard were obtained.

0893 Gopal, M. 1972. **Delimiting regions of provenance of teak for seed improvement and certification**. Proceedings of Symposium on Man-Made Forests in India, 8-10 June, 1972, Society of Indian Foresters, Dehra Dun. Forest Research Institute, Dehra Dun.

Tree seeds are classified into following four categories, seeds from known administrative region, seeds from known regions of provenance, selected seeds, and certified seeds. This paper analyses the various steps involved in production of seeds of above four categories.

0894 Gradual, L; Kjaer, E.D; Suangtho, P; Saosaard, A. 1999. **Conservation of genetic resources of teak (*Tectona grandis*) in Thailand**. Danida Forest Seed Centre, Denmark, Technical Note 52.

0895 Graudal, L; Kjaer, E.D; Thomsen, A; Larsen, A.B. 1997. **Planning national programmes for conservation of forest genetic resources**. Danida Forest Seed Centre, Humlebaek, Technical Note 48: 58p.

This note provides a practical framework for planning and implementation of national forest gene conservation programmes. Selection of priority species, assessment of their genetic variation, assessment of their conservation status, identification of population to be conserved, identification of appropriate conservation measures, organization and planning of specific conservation activities and preparation of management guidelines for the objects of conservation are described.

0896 Gunaga, R.P; Vasudeva, R. 2003. **Causes for low fruit production in clonal seed orchards of teak (*Tectona grandis* Linn.f.) in India**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

This paper deals with the causes for low fruit production in seed orchards; it reviews the available literature on the topic and attempts to suggest a few management practices.

0897 Gunaga, R; Vasudeva, R. 2002. **Genetic variation for fruiting phenology among teak clones of different provenances of Karnataka**. Indian Journal of Forestry 25(1/2): 215-220.

Significant variation is found among the clones of the clonal seed orchards for initiation and duration of fruit maturation. Clones derived from different provenances differed in their fruiting phenology and with respect to number of fruits per inflorescence. The estimates of the genetic parameters suggested that the time of fruit initiation was genetically controlled, while other traits were influenced by the environment.

0898 Hamzah, Z. 1977. **History of teak tree improvement**. (Indonesian). Duta Rimba 3(19): 21-30.

0899 Hanumantha, M. 2000. **Inter and intra clonal variation for reproductive traits in *Tectona grandis* Linn. f. Thesis**. University of Agricultural Sciences, Dharwad.

0900 Hanumantha, M; Gunaga, R.P; Vasudeva, R. 2001. **Variation for fruit parameters among teak (*Tectona grandis* Linn.f.) clones**. Journal of Tropical Forestry 17(1): 59-63.

Results of a study on fruit calyx, hairiness and splitting, which were qualitatively assessed in three rametes in a clonal seed orchard in Karnataka, India.

0901 Harahap, R.M.S; Soerianegara, I. 1978. **Heritability of some characters in teak (*Tectona grandis* Linn.f.)**. Proceedings from the Third World Consultation on Forest Tree

Breeding: Population Improvement Vol. 2: 649-657. CSIRO, Canberra, Australia.

The heritability of some characters in teak plantation has been determined.

0902 Hedegart, T. 1971. **Initiation of teak (*Tectona grandis* Linn.f.) provenance research in Thailand**. Vanasarn 29(2): 18-26.

The initial stage of provenance research on *T. grandis* by the Thai/Danish Teak Improvement Centre is described. There were significant differences between provenances in growth in the nursery, and also in survival and height. Recommendations are made on the collection of seed and the establishment of trials.

0903 Hedegart, T. 1971. **The Thai Danish Teak Improvement Centre five years after initiation**. Unasylva 25(1): 31-37.

Observations on clone collections, clonal seed orchards and provenance trials at the centre are discussed. Mention is made of a machine for removing exocarps and the results of nursery experiments are summarized.

0904 Hedegart, T. 1974. **The Teak Improvement Centre ten years after initiation**. Vanasarn 32(4): 342-358.

Reviews the activities of the Centre after ten years and presents the third 5-year programme of work on teak breeding, provenance evaluation and silviculture.

0905 Hedegart, T. 1975. **Breeding systems, variation and genetic improvement of teak (*Tectona grandis* Linn.f.)**. Tropical Trees, Variation, Breeding and Conservation. Linnean Society of London: 109-123. J. Burley; B.T. Styles, Eds. Academic Press, New York.

Available statistics of the teak forests of the world are presented. The species' breeding systems are discussed with emphasis on flowering and pollination. Stand structure, seed setting, seed distribution and regeneration are briefly discussed. The species genetic variation between populations and between individuals is reviewed. The necessity of conservation of gene resources is stressed. The importance of an economic evaluation of the breeding programme is mentioned. A proposal for global or regional coordination of research activities and education is presented.

0906 Hedegart, T. 1995. **Teak improvement for Myanmar and Laos**. FAO Consultancy Report April 1995.

0907 Hedegart, T. 1995. **Teak improvement programmes for Myanmar and Laos**. Hanoi: 29p.

0908 Hedegart, T; Lauridsen, E.B; Keiding, H; Faulkner, R. 1975. **Broad-leaved seed orchards. Part D - Teak**. Seed orchards. Forestry Commission Bulletin 54: 139-142.

Apart from several aspects of orchard establishment and management, a detailed description is given of flowering behaviour and natural pollination.

0909 Hellinga, G. 1956. **On forest tree improvement in Indonesia**. Proceedings of the IUFRO Meetings 22: p101.

0910 Hidalgo, E; Moreno, V; Morales, N. 1986. **Performance of 15 provenances of teak (*Tectona grandis*) five years after planting in Itabo, Matanzas**. (Spanish). Revista Forestal Baracoa 16(1): 65-75.

Data are presented on the survival, height and diameter of 15 provenances/sources, Indian, African, and Cuban grown on a typical red rendzina over limestone in NE Matanzas province, Cuba. The Olomu-Llorin provenance from Nigeria was very significantly superior to all other provenances. The Indian provenances were generally inferior. The Cuban sources Camaguey and Itabo can be used as seed sources until seed of the Olomu-Llorin provenance becomes available.

0911 Holmes, C.H. 1956. **Plantations and provenance trials of teak in Ceylon**. 12th Congress, International Union for Forest Research Organizations, Oxford, 1956 IUFRO/56/22/108: 2p.

Gives a brief history of introduction of teak in Ceylon. Ceylon joined in the all India Teak Seed Origin Trials in 1941 and seeds from local, Burma, Anamalai, Nilambur and Travancore origins were tried. The best results have been obtained from seeds of Indian origin. The method of pretreatment of seeds to stimulate and improve germination has also been described.

0912 Howcroft, N.H.S; Davidson, J. 1974. **Papua New Guinea tree introduction and improvement. Progress Report 1972-1974**. Papua New Guinea, Tropical Forestry Research Note 26: 9p.

Presents short reports summarizing progress made during the period 1972-1974

on different species including *Tectona grandis*.

0913 Hughes, C.E; McCarter, P.S; Apichart Kaosa ard; Koyo, J.P; Sim, B.L; Jones, N; Vigneron, P. 1984. **Voluntary papers on breeding programmes of broadleaves**. Provenance and genetic improvement strategies in tropical forest trees. Proceedings of a joint conference of IUFRO S2.02 08, S2.03-01, S2.03-13, Mutare, Zimbabwe, 9-14 April 1984: 521-618. Commonwealth Forestry Institute, Oxford.

It consists of five papers which include the paper Kaosa-ard, A. Teak improvement programme in Thailand.

0914 Indira, E.P. 1997. **Genetic improvement of teak in Kerala: Present status and future strategy**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 154-156. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

In Kerala, attempts to improve genetically the planting stock were made as early as 1961, with the selection of a few plus trees. With the joint effort of Kerala Forest Research Institute and Kerala Forest Department, a total of 750 ha of seed stands were marked as an interim source of better seeds until seed orchards are sufficiently productive. KFRI has selected 50 plus trees from various plantations in Kerala and established 3 pilot seed orchards. As the first phase of the planned genetic improvement of teak in Kerala is partly completed, the future scheme of work is discussed.

0915 Indira, E.P; Chacko, K.C; Krishnankutty, C.N. 1996. **Growth performance of teak nursery stock from genetically better sources for developing improved plantation technology**. KFRI Research Report 102: 49p. Kerala Forest Research Institute, Peechi.

The present study was undertaken to suggest methods to improve the nursery technology. The project also envisaged to estimate the mean number of plantable stumps per bed in teak nurseries in Kerala and to suggest an easy and indestructive plantability criterion. Performance of thirty one teak nurseries located in different parts of Kerala has been analysed in detail with respect to total and plantable stumps.

0916 IUFRO. 1981. **Species and provenance trials**. Wood production in the neotropics via plantations. IUFRO MAB USDA Forest Service, IUFRO Working Group S1.07.09, Puerto Rico, 8-12 September 1980: 137-263.

Included papers on provenance trial of different species. A paper, Keogh, R.M. Teak (*Tectona grandis* Linn.f.): Provenances of the Caribbean, Central America, Venezuela and Colombia is also included.

0917 Jayasankar, S; Babu, L.C; Sudhakara, K; Kumar, P.D. 1999. **Evaluation of provenances for seedling attributes in teak (*Tectona grandis* Linn.f.)**. Silvae Genetica 48(3/4): 115-122.

A provenance trial in teak involving seven provenances from Kerala was conducted. Data were compiled on germination characteristics and seedling performance in the nursery, and also on root growth potential and field establishment using stumps. Analysis of variance demonstrated profound variation in seedling growth rates among the provenances.

0918 Jayasankar, S; Sudhakara, K; Babu, L.C. 2003. **Provenance variation in growth, physiology, anatomical characteristics and foliar nutrient status of teak (*Tectona grandis*) seedlings**. Journal of Tropical Forest Science 15(1): 37-50.

Teak seedlings representing seven provenances from Kerala were examined for their differences in characteristics. Data were collected on growth attributes, physiological and anatomical parameters and foliar nutrient status of the seedlings. Large variations among provenances were observed in growth characteristics such as dry weight of stem, leaf and root and specific leaf area.

0919 Jones, N. 1968. **Plant breeding: Problems with forest tree species in West Africa**. Report from Ghana Journal of Agricultural Science, Accra 1(1): 21-28.

An account of the work carried in Nigeria and Ghana on six indigenous species and four exotic species including *Tectona grandis* is given. The problems of choosing species for study and selecting elite trees are discussed. Difficulties regarding the collection and transport of scion material are described. Grafting techniques are discussed.

0920 Jones, N. 1969. **The relationship between the form and value of some tree species in West Africa**. 2nd FAO/IUFRO World Consultation on Forest Tree Breeding, Washington FO-FTB-69-3/6: p12.

The species chosen in Ghana and Nigeria for selection of provisional plus-trees are listed which include the exotic trees, *Tectona grandis* and *Cedrela odorata*. Typical defects of form are described.

0921 Kadambi, K. 1945. **Teak-seed origin experiments in Mysore**. Indian Forester 71: 265-269.

It has long been observed by forest officers in Mysore that teak seed from the Kahankote district of Mysore, when used in plantations, produces stunted, relatively low, branchy trees with a relatively large number of insect galls. Trees of this origin are also more susceptible to defoliator attack, shed their leaves earlier, and sprout later. A study of the influence of teak seed provenance was studied and the results are analysed.

0922 Kedharnath, S. 1980. **Genetic improvement of forest trees**. Second Forestry Conference, Dehra Dun.

0923 Kedharnath, S. 1982. **Plus tree selection - a tool in forest tree improvement**. Improvement of Forest Biomass. P.K. Khosla, Ed.

0924 Kedharnath, S. 1985. **Breeding for insect resistance in forest trees**. Dr. T.V. Ramakrishna Ayyar Centenary Memorial Lecture, Loyola College, Madras 5.

0925 Kedharnath, S; Chetty, C.K.R; Rawat, M.S. 1969. **Estimation of genetic parameters in teak (*Tectona grandis*) without raising progeny**. Indian Forester 95(4): 238-245.

A method developed for coconuts was tested on teak. Genetic correlation of girth and number of internodes was found. It was shown that, in a small compact area of teak raised from seed, the environmental component of variation is negligible.

0926 Kedharnath, S; Mathews, J.D. 1962. **Improvement of teak by selection and breeding**. Indian Forester 88(4): 277-284.

A long-term programme for the improvement of teak by selection and breeding has been taken up by the Forest Research Institute, Dehra Dun with the object of producing superior varieties for growth on dry, semi-moist and moist teak forest types. The programme is described in stages, those of selection, propagation, testing, and finally production of seed and plants of the improved varieties.

0927 Kedharnath, S; Rawat, M.S; Chauhan, V.S. 1970. **Early growth performance of twenty clones of teak (*Tectona grandis* Linn.f.) in a seed orchard**. Proceedings of the Seminar-cum-Workshop on Genetic Improvement of Forest Seed in India, Dehra Dun: 86-89.

Clone seed orchard established in the New Forest, Dehra Dun were observed for studying growth of scion, number of internodes on the leader and average internodal length. The clones from Orissa, Madhya Pradesh and Mysore are observed to be outstanding in the three characters observed. Clones with more internodal and maximum internodal length are observed to be more vigorous.

0928 Keiding, A.H; Kjaer, E.D. 1998. **Teak - A tree with great potential**. (Danish). DST Dansk Skovbrugs Tidsskrift 83(4): 125-140.

A review is presented of the planting, growing and use of *Tectona grandis* in Thailand. Topics discussed include cooperative studies between Thailand and Denmark, vegetative propagation methods, work of the Teak Improvement Centre, international provenance testing, isoenzyme studies, genetic resource evaluation and prospects for the future.

0929 Keiding, H. 1972. **Seed orchards of *Hevea* and teak**. Forest tree improvement. 4. Symposium on seed orchards in honour of C. Syrach Larsen, Denmark, 7-8 October 1968: 107-123. Copenhagen, Akademisk Forlag, Denmark.

Selection work in seed orchards of teak is surveyed, reference being made mainly to studies carried out in Thailand.

0930 Keiding, H; Boonkird, S; Bryndum, K. 1966. **Aim and prospects of teak breeding in Thailand (II) Flowering of teak. (III) The germination of teak**. Natural History Bulletin of the Siam Society 21(1/2): 45-62; 69-73; 75-86.

Describes the programme of work for the Thai/Danish Teak Improvement Centre, Thailand. Gives a short account of the flowering habit of teak in relation to its effect on branching and height growth. Discusses the slow and sporadic germination of teak seed, and gives results of nursery experiments showing that the germination rate can be increased considerably by removing the exocarp from the fruit.

0931 Keiding, H; Jones, N; Webb, D. 1964. **A programme of tree breeding for Nigeria**.

Commonwealth Forestry Review 43(4): 319-326.

Describes the programme for the improvement, protection and establishment of seed orchards for four exotic and five indigenous species including teak. Budding and grafting have been reported successful for *Tectona grandis*.

0932 Keiding, H; Kemp, R.H. 1978. **Exploration, collection and investigation of gene resources: Tropical pines and teak**. Third World Consultation on Forest Tree Breeding, Canberra, Australia, 21-26 March 1977, v 1: 13-31. CSIRO, Australia.

Several hundred field trials have been established in over 40 countries and differences in growth rates and form have been found between provenances in species including teak. Several problems in exploration and collection of seeds and solutions are dealt with.

0933 Keiding, H; Lauridsen, E.B; Wellendorf, H. 1984. **Evaluation of a series of teak and Gmelina provenance trials**. Danida Forest Seed Centre, Denmark, Technical Note 15: 42p.

Tectona grandis and *Gmelina arborea* provenance trials in SE Asia and Africa were assessed. The development of an assessment procedure suited to the special features of broadleaved species is described.

0934 Keiding, H; Lauridsen, E.B. 1989. **Utilizing the results of international trials of teak and Gmelina**. Breeding Tropical Trees: Population structure and genetic improvement strategies in clonal and seedling forestry. Proceedings of the IUFRO Conference, Thailand, November 1998: p474. Oxford Forestry Institute, Oxford and Winrock International, Virginia.

Assessed the provenance trials of teak at the age of 9-10 years. The contribution with seed to the scheme by the Government of Thailand, India, Indonesia, Laos, Philippines, Ivory Coast, Togo, Nigeria, Tanzania, Malawi, Sri Lanka and Brazil are assessed.

0935 Keiding, H; Wellendorf, H; Lauridsen, E.B. 1986. **Evaluation of an international series of teak provenance trials**. 81p. Danida Forest Seed Centre, Humlebaek, Denmark.

An assessment was made of provenance trials in Papua New Guinea, Thailand, India, Brazil, Nigeria, Ghana, Ivory Coast, Mexico and St. Croix, W. Indies. Performances of provenance regions are tabulated for four plantation/breeding zones.

0936 Kerala Forest Research Institute, Peechi. 1982. **How to establish seed orchards of teak**. (Malayalam; English). KFRI Information Bulletin 5: 10p. Kerala Forest Research Institute, Peechi.

Based on work in Kerala where seed orchards have been established by grafting scions from plus trees. This bulletin covers the following topics; selection of plus trees and progeny testing, collection of scionwood, grafting methods, layout designs and spacing, cost of teak orchard establishment and the gain expected.

0937 Kertadikara, A.W.S; Prat, D. 1995. **Gene diversity study based on isozyme analysis in teak (*Tectona grandis* Linn.f.) provenances**. Proceedings of IUFRO Symposium of Measuring and Monitoring Biodiversity in Tropical and Temperate Forests, Bogor, 27 August-2 September, 1994. T.J.B. Boyle; B. Boontawee, Eds.

0938 Khemnark, B. 1964. **Teak improvement for Thailand**. Student Thesis, Faculty of Forestry, School of Forest Resources, University of Georgia, Athens, Georgia, Thesis 1969: 38p.

The proposed programme of Thai Danish Teak Improvement Centre is discussed. Study programmes include teak variation, selection of individual trees, clonal tests, provenance tests, progeny tests, seed sources and seed production areas, seed orchards, breeding program and heritability studies.

0939 Khemnark, C; Boonkird, S. 1963. **A preliminary study of different races of teak**. (Thai). Proceedings of the 3rd Agricultural Conference, Kasetsart University, Bangkok.

0940 Kittinanda, S.P. 1967. **Forest seed and tree improvement in Thailand**. Proceedings of Seminar on Forest Seed and Tree Improvement, Thailand: 22-26. Teak Improvement Centre, Ngao.

The present situation is reviewed on forest tree seed and tree improvement and future programmes indicated.

0941 Kittinanda, S.P. 1967. **Teak provenance trials**. (Thai). Proceedings of Seminar on Forest Seed and Tree Improvement, Thailand: 5p. Teak Improvement Centre, Ngao.

0942 Kittinanda, S.P. 1968. **Forest seed and tree improvement in Thailand**. Royal Forest Department, Bangkok R.109: 81p.

0943 Kittinanda, S.P. 1968. **Teak improvement research**. Proceedings of the seventh National Conference on Agricultural Sciences in Plants and Biology, Kasetsart University, Bangkok.

0944 Kittinanda, S.P. 1972. **Forest tree improvement plans in Thailand**. Proceedings of the Joint Symposia for Forest Tree Breeding of Genetics subject group IUFRO and Section 5, Forest Trees, SABRO, Tokyo, Japan 1972 B-7 (v): 4p. Government Forest Experiment Station, Japan.

The work of the Teak Improvement Centre and Pine projects were reviewed and the work done, includes establishment of seed source areas and seed orchards, selection of plus trees, vegetative propagation, provenance trials, clonal studies and control pollination. Emphasis to be laid on future plans is also given.

0945 Kittinanda, S.P. 1973. **Some problems in the production of improved forest tree-seeds in Thailand**. Proceedings of IUFRO Seed Symposium, Bergen, Norway, 4-14 September 1973, 33, Vol.2.

The importance of provenance research was stressed. The floral biology of teak is discussed and plantations of older than fifteen years are used for seed collection. Seed orchards under process of establishment may yield 100 kg per ha. when 15 years old. Establishment of seed center is recommended.

0946 Kjaer, E.D; Apichart Kaosa ard; Suangtho, V. 2000. **Domestication of teak through tree improvement: Options, potential gains and critical factors**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 161-190. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

The role of tree improvement for teak plantations is discussed with emphasis on possible gains and the key factors to be considered for successful tree improvement.

0947 Kjaer, E.D; Foster, G.S. 1996. **The economics of tree improvement of teak: (*Tectona grandis* Linn.f.)**. Danida Forest Seed Centre. Technical Note 43: 23p. DANIDA Forest Seed Centre, Denmark.

This paper discusses the economics of improving the genetic quality of teak through forest tree improvement. The paper is considered as a guide to the evaluation of the economics of genetic improvement of teak in country.

0948 Kjaer, E.D; Lauridsen, E.B; Wellendorf, H. 1995. **Second evaluation of an international series of teak provenance trials**. Danida Forest Seed Centre, Denmark: 118p.

This report presents the findings from the second evaluation of an international series of teak provenance trials. Seventy five seed provenances were sampled within eight zones: Moist India, semi moist India, dry India, Laos, Thailand and Indonesia plus landraces from Africa and Latin America. Eight of the original twenty one trials were reassessed to examine the development of the provenances and to ascertain whether the conclusions and recommendations resulting from the first evaluation were still valid. The data from all the eight evaluated trials is analyzed to examine the amount of interaction between trial regions.

0949 Kjaer, E.D; Lauridsen, E.B. 1996. **Results from a second evaluation of DFSC coordinated teak (*Tectona grandis*) provenance trials: Has new information been obtained?** Tree improvement for sustainable tropical forestry. QFRI IUFRO Conference, Queensland, 27 October-1 November 1996. Volume 1: 154-157. M.J. Dieters; A.C. Matheson; D.G. Nikles; C.E. Harwood; S.M. Walker, Eds. Queensland Forestry Research Institute, Australia .

A series of 48 provenance trials of teak were established by a number of countries during 1973-1976 as an international effort, initiated by the FAO Panel of Experts on Forest Genetic Resources, and co-ordinated by the Danida Forest Seed Centre. Eight trials have been assessed twice around age 9 and again at age 17 years, as a combined effort between trial host countries and the Danida Forest Seed Centre. Results are compared from the two evaluations.

0950 Kjaer, E.D; Siegismund, H.R. 1996. **Allozyme diversity in two Tanzanian and two Nicaraguan landraces of teak (*Tectona grandis* Linn.f.)**. Forest Genetics 3(1): 45-52.

Allozyme diversity was evaluated for two Tanzanian and two Nicaraguan landraces of teak and compared to the variation of four stands from within the natural distribution area as reference. It is thought that the genetic variation in the Tanzanian landraces has been enhanced following provenance hybridization, whereas the diversity in the Nicaraguan landraces may have been reduced because of bottlenecks. The allozyme diversity was found to be lower in the two Nicaraguan populations than in two Tanzanian.

0951 Konig, A; Venegas Tovar, L. 1981. **Forestry investigation and industrial development project, Colombia. Genetic improvement of forest trees**. FAO Report COL-74-005 Documento de Trabajo 33: 231p.

Preliminary results are presented of studies on timber species of the humid tropical and premontane humid forest zones in Colombia. The study includes species and provenance trials, progeny studies, studies on vegetative propagation, by cuttings or by grafting, phenological studies and establishment of seed crop stands.

0952 Kotwal, P.C. 1978. **Quantitative theory for the selection of superior phenotypes of forest tree species**. Journal of the Indian Botanical Society 57 Supplement 78.

Twenty external characters of teak were quantified for use in the selection of plus trees from which to establish clonal seed orchards producing high quality seeds. The grading system and its application are explained. This will help unbiased selection of plus trees and the maintenance of minimum selection standards.

0953 Kotwal, P.C. 1983. **Selection of superior phenotypes of teak in Madhya Pradesh**. Indian Journal of Forestry 6(1): 1-4.

Twenty external characters are identified as suitable for selection of plus trees for raising clonal seed orchards. These include height, girth, length of clear bole, stem form of buttressing, twisting, taper etc., epicormic branching, pest and disease susceptibility and seed production. The characters are graded 1-5 and descriptions of each grade are given in a table. Use of the grading system for selection of plus trees is briefly described.

0954 Krishna Murthy, A.V.R.G. 1997. **Teak improvement in Andhra Pradesh - its present status**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 171-174. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Seventy five plus trees of teak were selected and registered in 13 Forest Divisions of the State. A germplasm bank covering all the 75 plus trees was established in 4 different localities and about 65 plus seed production trees covering an area of 540 ha in 6 Forest Circles were selected, registered, and upgraded. There are 92 seed collection areas covering 6000 ha and about 2.5 lakhs of trees are available for seed collection.

0955 Kuang, B.C; Zhen, S.Z; Luo, M.X; Lin, M.P. 1996. **Evaluation of aggregate genetic value of main characters of provenances of teak**. (Chinese). Forest Research 9(1): 7-14.

Nine characteristics, describing the growth, quality and viability of teak provenances from India, Thailand and Nigeria were evaluated. The results show that there were significant or highly significant differences among provenances in all characteristics except survival rate. The relation between juvenile and mature teak trees indicates that it is possible to select superior trees at the seedling stage.

0956 Kuang, B; Zheng, S. 1992. **Genetic improvement of teak (*Tectona grandis*) in China**. Teak in Asia. Proceedings of the China/ESCAP/FAO Regional Seminar on Research and Development of Teak, Guangzhou, China, 19-27 March 1991, Technical Document GCP/RAS/134/ASB. FAO, Bangkok: 93-100. FORSPA Publication.

The authors report that Indian population is very complex in quantitative and qualitative characters; provenances from Mysore southwards have special leaf structure and strong drought/rust resistance and grow well in south Hainan province but a provenance from Maharashtra showed the worst growth and rust resistance ability. No significant differences in morphological structure were noted with provenances from Thailand.

0957 Kumar, A. 1992. **Teak seed improvement - achievements and problems**. Indian Forester 118(8): 525-533.

An account is given of the methods used and results obtained by the Maharashtra Teak Seed Improvement Programme. Seed orchards covering 166.5 ha have been raised after standardization of the method of vegetative propagation.

0958 Kumar, A. 1997. **Teak seed orchards in Maharashtra - some observations**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 160-164. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

At the Maharashtra Van Sanshodhan Sanstha, Chandrapur, an assemblage of 235 teak clones collected from 12 different States has been developed. Bud grafting of teak stumps has been employed. About 450 ha of good teak stands in natural forests have been identified for seed collection. Observations on flowering, fruiting and seeding of different clones and problems of management of teak seed orchards are highlighted.

0959 Kumar, A; Gogate, M.G; Sharma, R; Mandal, A.K. 1997. **Genetic evaluation of teak clones of Allapalli region, Maharashtra**. Indian Forester 123(3): 187-189.

A progeny test was carried out with teak in Chandrapur, Maharashtra, using seedlings raised from open pollinated seeds from clonal seed orchards. Observation on genetic variation indicated significant genetic variation at the family level. Height recorded both high heritability and genetic gain values. It is suggested that these clones can be used in breeding as well as in the production of advance generation populations in teak.

0960 Kumar, V; Kotrange, H.R; Dhotekar, U.P. 1998. **Genetic improvement of teak**. Indian Forester 124(9): 687-695.

A brief account is given of the teak genetic improvement programme of Maharashtra Van Sanshodhan Sanstha, Chandrapur, an organization set up in 1968 by the Maharashtra Forest Department. Aspects of the work described are the systematic selection of seed production areas, selection of plus trees, the establishment of clonal seed and seedling orchards, a national germplasm bank, and bud multiplication gardens, progeny testing and provenance trials.

0961 Kushalappa, K.A. 1986. **Tree improvement works in Karnataka**. Myforest 22(4): 201-210.

Tree improvement works include plus tree selection of different trees including *Tectona grandis*, teak germ plasm banks and seed orchards. *T. grandis* seed has been collected from eight selected plantations.

0962 Laurie, M.V. 1938. **Branching and seed origin in Coorg teak plantations**. Indian Forester 64(10): 596-600.

Four different types of branching seen in Coorg Teak plantations are described and illustrated and its herditary factors is discussed. It appears that varieties arising from seeds from dry localities may have considerably exaggerated characteristics when raised in damper and more favourable conditions. The necessity for ascertaining that the seed comes from a good origin when making Teak plantations is emphasized.

0963 Laurie, M.V; Sen Gupta, J.N. 1941 . **The importance of seed origin. Summary of results to date of the All-India Co-operative Teak Seed Origin Investigation**. Proceedings of the 5th silvicultural Conference, Dehra Dun, 1939: 103-121.

In the first paper details are given of the characteristics of 24 species of Indian trees exhibiting individual and racial variation in the timber, growth form hardiness, yield of oil, resin or other minor products, etc. The second paper discusses and summarizes the results of an investigation on the influence of the origin of seed of *Tectona grandis* on plant development and the characteristics of the crop raised.

0964 Loekito, D. 1959. **Selection of teak. III. Growth after 25 years**. Communication of Forest Research Institute, Bogor 70: 39p.

Results after 25 years of a provenance trial of nine foreign and nine Indonesian provenances laid out in 1932 are reported. The study in 1958 showed that, among the foreign provenances, Malabar and Indo-China teak had best height and girth, and Siam Teak the best stem form, with only slight branching. Indonesian provenances gave good results.

0965 Lokmal, N. 1995. **A note on the establishment of a clonal seed orchard of *Tectona grandis***. Journal of Tropical Forest Science 7(3): 510-512.

The establishment of a clonal seed orchard of 37 plus trees is described on a 1.6 ha site at Bukit Forest Reserve, Peninsular Malaysia. Bud sticks of the selected trees were collected, bagged, and sent in an ice pack to Pulau Langkawi, where they were grafted in the field onto rootstocks raised from 6-month-old potted seedlings. Initial budding success was about 70 percent and the number of ramets per clone was 1-10.

0966 Luckins, C. Babu; Gopikumar, K; Vijayakumar, N.K. 1997. **Genetic improvement of teak (*Tectona grandis*) for Peninsular India**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 143-148. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

The paper highlights the present status of genetic improvement in teak and gives a brief account on various regeneration techniques. The paper discusses on how to start a breeding programme in teak by selecting plus trees from base population representing different agro-climatic zones, seeds collection, progeny test, establishment of first generation clonal orchard, preparation of grafts, etc. The phase II of the programme includes forming a breeding population and making crosses among the best parents.

0967 Madoffe, S.S; Chamshama, S.A.O. 1989. **Tree improvement activities in Tanzania**. Commonwealth Forestry Review 68(2): 101-107.

At present there are about 78 000 ha of exotic plantations in Tanzania including *Tectona grandis*. Tree improvement activities aimed at survival, growth and stem form are briefly reviewed under the headings: species trials and arboreta, provenance testing, progeny testing, seed stands, production seed orchards and plus trees and clone banks.

0968 Madoffe, S.S; Maghembe, J.A. 1988. **Performance of teak (*Tectona grandis* Linn.f.) provenances seventeen years after planting at Longuza, Tanzania**. Silvae Genetica 37(5/6): 175-178.

The provenance trial, comprising seed sources from Tanzania, India, Java, New Britain, Nigeria, Sudan, Trinidad and Vietnam was established. Analysis of variance of data compiled on survival, growth and stem characteristics over 17 years demonstrated fairly uniform survival and growth rates among provenances. It is recommended that selection for tree improvement be made from superior trees of all the provenances in order to maintain a broad genetic base for teak in Tanzania.

0969 Mahapatra, P. 1970. **Establishment of seed production areas for teak, *Casuarina* and *Eucalyptus***. Proceedings of Seminar-cum-Workshop on Genetic Improvement of Forest Tree Seed in India, Dehra Dun: 75-79.

Describes the criteria followed in selection of teak seed production areas consequent to large scale teak plantations undertaken in Maharashtra state.

0970 Mandal, A.K; Lal, R.B; Gupta, B.N. 1998. **An improved method for selection of seed stands for conversion into seed production areas**. Indian Forester 124(11): 918-924.

This paper describes a suitable method for the selection and treatment of candidate seed stands of teak. The steps include selection of stands in different ecoclimatic zones of the state/country, selection of the best areas within the selected stands and selection of trees for retention/culling in the candidate seed stands.

0971 Mandal, A.K; Rambabu, N. 2000. **Quantitative genetic aspects of teak improvement**. Genetics and Silviculture of teak. International Book Distributors, Dehra Dun. A.K. Mandal; S.A. Ansari, Eds.

0972 Mandal, A.K; Sharma, R; Gupta, B.N. 1997. **Establishment and management of seed production areas**. TFRI Publication 5: 14p. Tropical Forest Research Institute, Jabalpur.

0973 Mathauda, G.S. 1954. **The all-India teak seed origin sample plots**. Indian Forester 80(1): 10-23.

The sample plots were laid out in 1930. Local seed is likely to give good results but may not prove to be the best. Of imported seed, that from dry localities is usually inferior to that from moist.

0974 Meekaew, P. 1992. **Genetic variation of growth, seed production and foliar nutrients of teak**. M.Sc Thesis. Kasetsart University, Bangkok.

0975 Mitarini, D; Harahap, R.M.S. 1994. **Differences between teak stands of clonal origin and seed origin in Saradan**. (Indonesian). Duta Rimba 20(173/174): 11-14.

Comparative growth data are given for a 41-yr-old clonal stand of teak and a seed origin stand. Total height and diameter were similar in the two stands, but bole height was greater in the clonal stand, while basal area, total volume and clear bole volume were more in the seed origin stand.

0976 Mkilanya, P.M. 1978. **Local provenance trials in Tanzania**. Progress and problems of genetic improvement of tropical forest trees.

Proceedings of a joint workshop, IUFRO working parties S2.02-08 and S2.03-01, Brisbane, 1977. V. Provenance trials and breeding programmes. G. Other softwood species: 850-856. Commonwealth Forestry Institute, Oxford.

Trial plantings of various tree species have been made since 1967 and details are given of the eleven most promising species including teak.

0977 Mukewar, A.M. 1997. **Accelerated breeding strategy for tree improvement and quality seed production of teak in India**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 149-153. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Discussed the general importance of tree improvement and illustrated the cost benefit ratio of tree improvement. Dealt with occurrence of teak, early breeding work and present status of teak improvement in India. Stressed the efficacy of accelerated tree breeding method with due emphasis on flowering of teak, flowering stimulus, floral biology and possible use of precocious flowering teak mutant in reducing the interval between breeding cycles and also for mass production of quality seeds in seed orchards.

0978 Muniswami, K.P. 1978. **Population improvement and hybridization - teak**. World Consultation on Forest Tree Breeding, Canberra, Australia, 3rd, 21-26 March 1977. v. 2: 507-544. CSIRO, Canberra.

Teak improvement through exploitation of ecotypic variation, selection and demarcation of seed production areas and selection of plus trees and establishing clonal orchards is discussed. A method of surveying and delineating promising provenances is suggested.

0979 Murillo, O. 1992. **Methodology for the design and establishment of seed stands**. Tecnologia en Marcha 11: Numero Especial: 3-13.

An account of the objectives and minimum criteria for seed stands and the stages in the process of selecting and establishing seed stands of *Tectona grandis* and *Bombacopsis quinatum* in Costa Rica is given.

0980 Nagarajan, B; Varghese, M; Nicodemus, A; Sasidharan, K.R; Bennet, S.S.R; Kannan, C.S. 1996. **Reproductive biology of teak and its implication in tree improvement**. Tree improvement for sustainable tropical forestry. QFRI IUFRO Conference, Queensland, Australia, 27 October-1 November 1996. Volume 1: 244-248. M.J. Dieters; A.C. Matheson; D.G. Nikles; C.E. Harwood; S.M. Walker, Eds. Queensland Forestry Research Institute, Australia.

One serious problem encountered in teak improvement programmes is low seed production in breeding plantations. Floral characteristics and seeding parameters of four teak clones in a germplasm bank from Central India and a clonal seed orchard in Southern India were studied. The clones differed in flower production per inflorescence, fruit set, fruit diameter and weight and in percentage of seed filled between locations.

0981 Nicodemus, A; Nagarajan, B; Mandal, A.K; Subramanian, K. 2000. **Genetic improvement of teak in India**. Proceedings of the 3rd Regional Seminar on Teak - Potentials an Opportunities in Marketing and Trade of Plantation Teak: Challenge for new Millennium, Yogyakarta: 277-294. Hardiyanto, E.D, Ed.

0982 Nicodemus, A; Nagarajan, B; Narayanan, C; Varghese, M; Subramanian, K. 2003. **RAPD variation in Indian teak populations and its implications for breeding and conservation**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Genetic variation in teak populations from Western Ghats and central regions of India were studied using Random Amplified Polymorphic DNA (RAPD) markers. The Western Ghats populations had more diversity compared to those from Central India. Partitioning of genetic diversity into within and between population showed that seventy eight percent of variation existing within populations and the rest between populations. A negative relationship is observed between latitude and within population diversity.

0983 Norwati, A; Abdullah, R; Norlia, B; Rosli, H.M. 2001. **Direct DNA transfer into teak (*Tectona grandis*) cells via microprojectile bombardment**. Tropical forestry research in

the new millennium: Meeting demands and challenges. Proceedings of the International Conference on Forestry and Forest Products Research, 1-3 October 2001, Kuala Lumpur: 539-541. Forest Research Institute Malaysia, Kuala Lumpur, Malaysia.

0984 Nuthan, D. 2000. **Genetic variability and productive potentiality of teak (*Tectona grandis* Linn.f.) across different provenances in Karnataka**. Ph.D Thesis: 199p. Forest Research Institute, Deemed University, Dehra Dun.

0985 Odeyinde, M.A. 1974. **Lightning damage in a teak seed orchard at Onigambari**. Obeche 10: 105-107.

Records a lightning strike that occurred in July 1973 in a 9-year-old *Tectona grandis* seed orchard at Gambari, Nigeria, affecting a group of 9 trees covering an area of 0.34 ha.

0986 Oduwaiye, E.A. 1983. **An analysis of experimental data on the establishment of clonal seed orchards of three exotic forest tree species through vegetative propagation**. Thesis Summary. Forestry Abstracts 44(10): p607.

Including Tectona grandis.

0987 Ojo, G.O.A. 1974. **Thoughts on tree improvement programmes for some savanna plantation species**. Federal Department of Forest Research, Nigeria, Savanna. Research Paper 35: 4p.

The possibilities are discussed of improving several species including teak in savanna planting in Nigeria.

0988 Oka, A.G. 1986. **Genetic resources for teak plantations in Maharashtra States**. Regional Meeting of Silviculturist and Research Workers of Central Zone: 37-52.

0989 Omoyiola, B. 1974. **Comparison of four Nigerian teak seed sources**. Forest Series, Federal Department of Forest Research, Nigeria, Research Paper 23: 10p.

Trials of four provenances of *Tectona grandis* were established at three sites in the Benin area of Nigeria. No significant differences were noted between the seed sources in survival, total and mean base area of tree at any of the sites. But there were significant differences between sites for survival and for total and mean base area of the young trees.

0990 Palupi, E.R; Owens, J.N. 1996. **Reproductive biology of teak (*Tectona grandis* Linn.f.) in east Java, Indonesia**. Tree improvement for sustainable tropical forestry. QFRI IUFRO Conference, Queensland, Australia, 27 October-1 November 1996. Volume 1: 255-260. M.J. Dieters; A.C. Matheson; D.G. Nikles; C.E. Harwood; S.M. Walker, Eds. Queensland Forestry Research Institute, Australia.

Reproductive biology of teak in a clonal seed orchard in East Java, Indonesia was investigated and causes of low fruit and seed set were identified. Fruit maturation in relation to low fruit germinability was studied. The major cause of seed abortion was reported as failure of endosperm development which may result from a higher incidence of self-pollination.

0991 Palupi, E.R; Owens, J.N. 1998. **Reproductive phenology and reproductive success of teak (*Tectona grandis* Linn.f.)**. International Journal of Plant Sciences 159(5): 833-842.

Three clones, with low, medium and high fruit production capacities were selected from a 10-year-old clonal seed orchard and the reproductive phenology and reproductive success of the clones were determined. The low fruit production capacity of clone was reported of early flowering, while the high fruit production capacity of clone is reported coincided with the peak flowering period. The major constraints in teak reproduction were reported as low fruit and seed set.

0992 Pan, Y.F; Kuang, B.C; Liu, W.M. 1999. **Test of acid and aluminium-tolerance of teak clones**. (Chinese). Forest Research 12(2): 152-159.

Drought resistant, acid tolerant and fast growing teak trees were selected from six provenances of the countries India, Nigeria and China and tested for acid and aluminium tolerance of the trees and the results are presented.

0993 Paosujja, R. 1971. **Teak seed orchard in Thailand**. (Thai). Proceedings of the Second Forestry Conference, Royal Forest Department, Bangkok R.129: 37-44.

The teak seed orchard work in Thailand, its progress and problems encountered are presented and discussed.

0994 Parthiban, K.T; Surendran, C; Paramathma, M; Sasikumar, K. 2003. **Molecular characterization of teak seed sources using RAPDs**. International Conference on Quality

Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Teak seed sources from 30 locations (28 from India and one each from Lao PDR and Bangladesh) were characterized using RAPD's with 17 primers. Jaccard's similarity index revealed that a highest genetic distance of 0.457 was observed between Kerala III and Uttaranchal. The resultant phenotic tree indicated that the populations from each state were found to be grouped within the same sub-clusters barring a few seed sources revealing the identity of each population.

0995 Perera, W.R.H. 1961. **Teak seed orchards. Stage 1-plus trees and perfection of a bud-grafting technique**. Ceylon Forester 5(1/2): 6-16.

Describes experiments with two methods of grafting-the forkert and the `T' or shield budding method. Covering the bud-patch with a piece of leaf before tying gave improved results.

0996 Persson, A. 1971. **Observations from a progeny trial of *Tectona grandis* Linn.f. at Longuza, Tanga region, Tanzania**. Silviculture Research Note, Tanzania 24: 11p.

Describes trials of progenies obtained by open pollination of 28 mother trees in three plantations in Tanzania. Significant differences between progenies in base area and degree of fluting, and significant differences in height were noted after four years of planting. Methods of improving the genetic quality of the *T. grandis* planting stock used in Tanzania are discussed.

0997 Persson, A. 1971. **Observations from a provenance trial of *Tectona grandis* Linn.f. at Longuza, Tanga region, Tanzania**. Silviculture Research Note 22: 13p.

0998 Pinyopusarek, K; Keiding, H. 1981. **Proposal for standardising assessments in international provenance trials of teak, *Tectona grandis* Linn.f**. DANIDA Forest Seed Centre, Circular Letter 15: 20p. DANIDA Forest Seed Centre, Denmark.

The authors tested a preliminary assessment procedure with regard to an example of an international teak provenance trial in Thailand and suggested it could have wider application in international coordinated teak provenance trials. Criteria selected related to the forestry view point and relate to habit and growth; may be modified to accommodate regional characteristics, but also to class differentiation within scorings.

0999 Piot, J. 1977. **Trial of ten *Tectona grandis* Linn.f. provenances in upper Volta**. Proceedings of the Joint IUFRO Workshop, Brisbane Vol.2: 758-788.

1000 Prachim Suksileung; Chuntanaparb, L; Choob Khemnark; Sutat Sriwatanaponge. 1975. **Clonal variation and inheritance in growth characteristics of teak (*Tectona grandis* Linn.f.)**. Kasetsart Journal 9(1): 1-11.

In sixteen clones in two clonal seed orchards studied for seed yield, diameter at breast height and height and found significant differences existed between clones for all characters at one locality. Heritability estimates for height were moderate and higher than those for diameter at breast height. Diameter at breast height was strongly correlated with height.

1001 Prawotosoedarmo, S. 1957. **Seed collection and seed gardens**. 2nd Session, FAO Teak Sub-Commission, Bandung, Indonesia FAO/TSC-57/26: 2p. FAO, Rome.

The studies of Eidmann on the influence of (a) time of collection, (b) age of mother stand, (c) size of seed on the germinative power of teak seed is described and his results are presented in the form of tables. A positive correlation is indicated between the germinative power and the growth in the first year.

1002 Purkayastha, S.K; Satyamurthi, K.R. 1975. **Relative importance of locality and seed origin in determining wood quality in teak**. Indian Forester 101(10): 606-607.

Analysis indicated that environmental influences had a much greater effect than seed source on the specific gravity of the wood and the growth rate of *Tectona grandis*.

1003 Rai, S.N; Parthasarathi, K. 1989. **Present status of forest tree improvement work in India**. Indian Forester 115(9): 603-612.

An outline is given of achievements and ongoing work in 13 states. The authors review the present status of tree improvement work and provide current information.

1004 Rao, P.S; Murali, V; Venkaiah, K; Murti, S.S.N. 2002. **Performance of teak (*Tectona**

grandis **Linn.f.) clones of Andhra Pradesh**. Indian Forester 128(12): 1288-1294.

Performance of teak bud wood grafts taken from twenty seven plus trees, representing different Forest Divisions of Andhra Pradesh were evaluated for stand volume, PAI and MAI.

1005 Rao, P.S; Venkaiah, K; Murali, V; Murti, S.S.N; Sattar, S.A. 2001. **Evaluation of International teak provenance trial plot in North East Andhra Pradesh**. Indian Forester 127(4): 415-422.

The International Provenance Trial Plot sponsored by FAO/DANIDA in collaboration with the Andhra Pradesh Forest Department was established in 1973 at Maredumilli, North-East Andhra Pradesh with teak seeds from India, Africa and Thailand and one local seed source as control. Analysis of variance of data on 26-year-old trees indicated non-significant differences among provenances in terms of height, clear bole height, diameter at breast height and crown, while significant differences were observed for survival rate, straightness and roundness of stem and health characteristics. The indigenous seed source 'Konni' (Kerala) and exotic source 'Ban Mae Pan' (Thailand) were found the best in all parameters studied.

1006 Rawat, M.S; Uniyal, D.P; Emmanuel, C.J.S.K. 1995. **Use of coppice shoots in seed production areas of teak: A new concept**. Indian Forester 121(6): 469-471.

The creation of seed production areas is an important interim step in the tree improvement programmes to enable the supply of superior seed for afforestation until seed orchards become fully productive. This paper suggests a new method which utilizes the coppicing capacity of teak. Coppiced/pollarded shoots flower and fruit abnormally early.

1007 Rawat, M.S; Uniyal, D.P; Sharma, S.L. 1998. **Identification of provenances based on leaf morphology in *Tectona grandis***. Indian Forester 124(4): 248-251.

Data on leaf morphological parameters are tabulated for 21 teak provenances from South and South East Asia grown from seed in the nursery at the Forest Research Institute, Dehra Dun. A study of these revealed certain diagnostic characters in plants 2 yr old, on the basis of which different provenances/sources could easily be identified.

1008 Resende, M.D.V de. 2001. **Workshop on the improvement of forest trees and palms in Brazil, Curitiba, 9-10 August 2001**. Documentos Embrapa Florestas 62: p245. Embrapa Florestas, Colombo, Brazil.

1009 Rimbawanto, A. 1995. **Tree breeding strategy for genetic improvement of *Tectona grandis* in Indonesia**. Duta Rimba 20(181/182): 13-19.

1010 Rimbawanto, A. 1998. **Application of DNA techniques in the improvement programme for teak (*Tectona grandis* Linn.f.) in Indonesia**. (Indonesian). Duta Rimba 23(212): 15-20.

1011 Sagreiya, K.P. 1962. **Orchard versus Naturalistic silviculture**. Proceedings of 5th World Forest Congress, Seatle, 1960. 1: 454-457.

Gives a description of mixed teak forests of Madhya Pradesh which are distinguished into three types; moist, semi-moist and dry types. The paper describes the condition of regeneration of teak and suggests how maximum yield of teak can be obtained by thinnings and silviculture.

1012 Sandiford, M. 1990. **An account of the identification of existing *Tectona grandis* populations in Solomon Islands. A first step toward the improvement of *Tectona grandis***. Forestry Division, Solomon Islands, Forest Research Note 61-01-90: 14p. Forestry Division, Honiara, Solomon Islands.

1013 Sekaran, S; Sasidharan, K.R; Nicodemus, A; Bachpai, V.K.W; Narayanan, C; Venkatasubramanian, N; Singh, B.G; Siddappa. 1999. **Criteria for establishment of seed production areas of teak, *Eucalyptus* and acacias**. National Symposium on Forestry towards 21st Century, Coimbatore.

1014 Sen Gupta, J.N. 1939. **The importance of the seed origin (Part II)**. Proceedings of 5th Silvicultural Conference, Dehra Dun Item 4: 109-120.

Discusses the results of an investigation on the influence of the origin of *Tectona grandis* seed on plant development and on the characteristics of the crop raised. For case of establishment and early development it seems that seed of local origin is superior to that of distant origin. Included is a key to the

morphological differences in races of teak based on leaf characters.

1015 Sharma, R; Mandal, A.K; Gupta, B.N; Jattan, S.S. 1996. **Progeny test in teak**. Indian Forester 122(3): 229-234.

The present status of knowledge on different genetic parameters such as variation, heritability and genetic gain, intercharacter relationships, and selection of the best general combiners is reviewed using the data on diameter, height and basal area growth from 4 progeny trials established in 1978-92, three in Maharashtra and one in Orissa.

1016 Sharma, R; Swain, D; Mandal, A.K. 2000. **Estimates of genetic parameters from an open pollinated genetic test of teak (*Tectona grandis*)**. Journal of Tropical Forest Science 12(1): 44-48.

Genetic parameters were estimated from a 7-yr-old open pollinated progeny test of teak in Orissa which used seeds from a clonal seed orchard established in Orissa using plus trees from 6 provenances from Orissa. The results indicated presence of significant genetic variation in the material studied. Height, diameter and basal area were found to be under the control of additive gene action. Basal area and diameter exhibited positive significant genetic correlation.

1017 Sharma, S.L; Rawat, M.S. 1998. **Genetic improvement of teak (*Tectona grandis*) in Forest Research Institute: An overview**. Indian Forester 124(8): 633-636.

A brief overview is given of tree breeding studies undertaken with teak in Indian Forest Research Institute at Dehra Dun, Uttar Pradesh.

1018 Singh, J.S. 1962. **The effect of planting teak of different seed origins on Gangetic alluvium**. Tropical Ecology 3(1/2): 119-138.

Presents data on growth performance in relation to the translocation and use of minerals in plantations. Growth of N. Burma provenance is found the best, followed by S. Burma, S. Bombay, Madhya Pradesh and N. Bombay. Leaf litter and soil analyses showed that the faster growing trees affect the mineral economy of the soil by increasing the mineral circulation and by the quantities of minerals removed when the trees are harvested or the litter removed.

1019 Singh, N.B; Beniwal, B.S. 1993. **Evaluation of teak germplasm**. Journal of Economic and Taxonomic Botany 17(2): 462-464.

Teak germplasm from 130 Indian genotypes was grafted onto local teak stumps at Chessa, Arunachal Pradesh and assessed for 10 characters - graft sprouting/incompatibility/survival, straightness, girth, crown form, height, disease and pest resistance, and flowering and fruiting.

1020 Sinha, A; Prasad, K.G. 2003. **Status and strategies for teak improvement in North East India**. Indian Forester 129(9): 1132-1140.

Presented the status of teak in North East India and discussed the variability in teak plantations and the strategies for their improvement.

1021 Soerianegara, I. 1971. **Forest tree improvement in Indonesia**. Rimba Indonesia 16(1/2): 11-19.

Reviews the progress of provenance trials of *Tectona grandis* in West, central and E. Java from 1930 onwards.

1022 Suangtho, V; Graudal, L; Kjaer, E.D. 1999. **Genecological zonation as a tool in conservation of genetic resources of teak (*Tectona grandis*) in Thailand**. International Teak Conference, Teak Beyond 2000, Chiang Mai, Thailand, 23-25 August 1999; Danida Forest Seed Centre, Humlebaek, Denmark: 8p.

1023 Subramanian, K.N. 1997. **Genetic improvement of teak in India**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 135-142. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

The main purpose of the breeding programme is to develop genetically upgraded planting material, suitable for growing in different ecoclimatic zones. Seed orchard is the permanent source of production of genetically improved seeds in desired quantity to improve the quality of plantations. 1000 ha of clonal seed orchards has been established in India. Teak can be vegetatively propagated by rooting, branch cutting, grafting, etc.

1024 Subramanian, K.N; Nicodemus, A; Radhamani, A. 1994. **Teak improvement in India**. Forest Genetic Resources 22: 33-36.

A brief account is given covering seed production areas, provenance trials, plus tree selection, seed orchards, progeny testing, vegetative propagation including tissue culture and future strategies for *Tectona grandis* in India.

1025 Sumantakul, V. 2002. **Forest genetic resources in Thailand**. Proceedings of the South-East Asian moving workshop on conservation, management and utilization of forest genetic resources, Thailand, 25 February - 10 March 2001. J. Koskela; S. Appanah; A.P. Pedersen; M.D. Markopoulos, Eds. FORSPA Publication 31: 93-104. FAO Regional Office for Asia and the Pacific, Bangkok, Thailand.

This paper describes the forest types and forest plantations of Thailand. Tree improvement activities began in 1965 with teak. The lists of priority species for conservation, tree improvement or seed procurement are provided.

1026 Sumantakul, V; Yingransiri, T. 1979. **Progeny test of teak (*Tectona grandis* Linn.f.) in diallel crosses**. (Thai). Report on Silviculture 1977-1978: p84. Royal Forest Department, Ministry of Agriculture and Cooperatives, Bangkok.

1027 Sumantakul, V; Yingransiri, T. 1979. **Provenance trial of teak at Amphoe Ngao, Lampang**. (Thai). Report on Silviculture 1977-1978. Ministry of Agriculture and Cooperatives, Bangkok, Royal Forest Department, Silviculture Division: 66-73.

1028 Suri, S.K. 1984. **Analytical study of teak provenance tests in North Raipur Division of Madhya Pradesh**. Indian Forester 110(4): 345-363.

Teak plantations were raised using seeds from Maharashtra, Burma, Kerala, Madhya Pradesh and Karnataka. Mean values of the growth parameters up to 50 yr old and results of statistical analysis are tabulated. Teak seeds from moist localities are shown to be bigger than those from dry zones. Germination and plant percent appear to depend on the quality of the seed rather than the size and weight. The height appears to be a function of site quality rather than seed origin.

1029 Tanskley, S.D; Mc-Couch, S.R. 1997. **Seed banks and molecular maps: Unlocking genetic potential from the wild**. Science 277: 1063-1066.

1030 Teak Improvement Centre, Ngao. 1965. **Teak improvement centre - Mac Huat teak plantations**. Progredds Report 4: 3p. Teak Improvement Centre, Ngao.

The first report after launching the joint collaboration project in 1965. The progress made and experiments undertaken on vegetative propagation of teak by bud grafting, establishment of a multiplication garden, observations on clonal collections, generative propagation, and flowering and controlled pollination were reported.

1031 Vaclav, E. 1972. **Provenance trials in Tanzania**. Vaclav, E: Seed stands and plus trees in Tanzania. Silvaecultura Tropica et Subtropica 2: 87-101.

Summarizes and evaluates the results of provenance trials established up to 1966 with *Pinus elliottii*, *P. radiata*, *P. taeda*, *Tectona grandis* and *Cupressus* spp.

1032 Vaclav, E. 1972. **Progeny trials in Tanzania**. Vaclav, E: Seed stands and plus trees in Tanzania. Silvaecultura Tropica et Subtropica 2: 69-86.

Evaluates the results of progeny trials of plus-trees established in Tanzania up to 1967 for different species including *Tectona grandis*.

1033 Vakshasya, R.K; Uniyal, D.P; Rawat, M.S. 1988. **Teak plus trees for specific traits**. Indian Forester 114(3): 168-169.

Different types of plus tree selection are reported here. The first is a tree with wavy grain from a wet zone in Kerala. Trees with less straight grain reported as occurring in the dry zone.

1034 Valera, L; Garay, V; Dulhoste, R. 2001. **Variation in teak plantations (*Tectona grandis* Linn.f.) in the Ticoporo Forest Reserve, Venezuela. Basis for an improvement program**. (Spanish). Revista Forestal Venezolana 45(2): 145-152.

Morphological variation of teak was determined from 24-25 years old plantations established with seed from Trinidad. Stands with silvicultural thinning and with genetic thinning were there. Each tree was evaluated taking stem and crown morphology, as well as quantitative traits of diameter and height. Selected trees were evaluated using phenotypic criteria.

1035 Varghese, M; Nicodemus, A; Nagarajan, B. 2003. **Fertility variation and dynamics of two clonal seed orchards of teak**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Fertility differences between clones were estimated in two 25 year old clonal seed orchards of teak in South India.

1036 Vasudeva, R; Gunaga, R; Hanumantha, M. 2003. **Implications of clonal variation in reproductive traits to improvement of teak (*Tectona grandis* Linn.f.)**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Estimated inter and intra clonal variation for reproductive traits in a 20 year old clonal seed orchards in Karnataka. Inter clonal variation was significant for majority of fecundity and phenological traits suggesting a strong genetic control. Strong provenance effect of phenology was observed.

1037 Venkataraman, K.G. 1973. **Importance of seed origin in provenance research in teak (*Tectona grandis*)**. Forestry Conference (Silvicultural Conference) 6-10 December 1973, 61. Forest Research Institute, Dehra Dun.

The nature of variation within a species are demonstrated and evaluated by growing sample from the entire ranges of the species, in-adequately replicated experiment in one or more location. This forms the basis of seed source trial.

1038 Venkatesh, C.S; Koshy, M.P; Chacko, K.C; Indira, E.P. 1986. **Genetic improvement of teak (*Tectona grandis* Linn.f.) in Kerala**. KFRI Research Report 13: 21p. Kerala Forest Research Institute, Peechi.

Results of the project undertaken with the objective of selection of seed stands and plus trees and establishment of pilot seed orchards are presented. Plantations superior in vigour and growth compared to adjoining areas were selected and converted to seed production areas. Fifty trees, outstanding in growth and stem form designated as plus trees have been selected in different teak growing areas in Kerala using check tree method.

1039 Vivekanandan, K. 1975. **The present status of tree improvement work in Sri Lanka**. Sri Lanka Forester 12(2): 95-100.

Breeding and provenance trials are performed with teak (*Tectona grandis*), *Eucalyptus* and tropical Pinus species.

1040 Vivekanandan, K. 1977. **First year results of the teak provenance trials in Sri Lanka**. Sri Lanka Forester 13(1/2): 31-33.

1041 Watanabe, A; Widyatmoko, A; Rimbawanto, A; Shiraishi, S. 2004. **Discrimination of teak (*Tectona grandis*) plus trees using selected random amplified polymorphic DNA (RAPD) markers**. Journal of Tropical Forest Science 16(1): 17-24.

To achieve a highly reliable clone management of teak plus trees, useful DNA molecular markers were surveyed using RAPD analysis and their ability to discriminate among plus tree clones was examined. Evaluation of the discriminatory powers of the fragments suggested that the selected RAPD markers would be useful in the clone management of teak plus trees.

1042 Wellendorf, H; Apichart Kaosa ard. 1988. **Teak improvement strategy in Thailand**. Forest Tree Improvement, Arboretet Horsholm, Denmark 21: 43p.

The key elements of a tree improvement strategy are outlined. Extension of seed production areas; establishment of regional seed centres and nurseries, the Teak Improvement Center, Royal Forest Department of Thailand, to guarantee the source of collected seed, consolidation of the seed orchard areas with a broader clonal input, initiation of long-term breeding populations in order to maintain the capability for steady genetic improvement in future generations and flexibility to respond to changing breeding objectives.

1043 White, T. 1967. **A conceptual framework for the tree improvement programmes**. Martinus Nijhoff Publishers, Dordrecht.

1044 Wirjodarmodjo, H; Soebroto, P.M. 1983. **Teak improvement by Perum Perhutani**. Duta Rimba 9(63/64): 3-13.

1045 Wyatt Smith, J. 1961. **Provenance and progeny trials of teak in North-West Malaya**. Malaysian Forester 24(2): 126-141.

Germination percentage and height development in the nursery of selected teak seed of local and foreign origin are described. Early height and girth development in plantation of selected stump plants from the seedlings raised are noted.

1046 Yingransiri, T. 1980. **A review on genetic improvement of teak**. Vanasarn 37(1): 35-40.

A review of work at the Forest Research Institute, Dehra Dun, the Thai-Danish Teak Improvement Centre, Thailand and the FAO/Danish Forest Tree Seed Centre, Denmark. Additional work has also been carried out in Tanzania, Nigeria, Malaysia, Indonesia and Papua New Guinea.

1047 Zhang, R.G; Lan, M; Qiao, G.M; Wang, Y.G; Xie, X.R. 1999. **Provenance test on growth evaluation of teak in Honghe**. (Chinese). Forest Research 12(2): 190-196.

Remarkable differences in height and diameter at breast height were noted among provenances. Based on selection criteria of 10 percent over the standard provenance for diameter at breast height and 40 percent over for volume, eight provenances were considered fine.

1048 Zobel, B.J; Dorman, K.W; Arnason, A; Benedikz, T; Turnbull, J.W; Pitcher, J. 1973. **Forest genetic resources information - No. 2**. FAO Forestry Occasional Paper 2: 66p.

Contains several papers on forest genetics including a paper on the collection of *Tectona grandis* and *Pinus merkusii* seed by the Seed Centre, Humlebaek, Denmark.

Go top

Ecology and Distribution

1049 **Teak in Travancore**. Indian Forester 18, 1892: 385-386.

Leaf differences in teak are reported due to age. Young leaves are scabrous, serrate and obovate or even spatulate and after 5-6 months become glabrous and ovate and darker-coloured. Also describes methods best suited for raising teak plantations in the area. In moisture climate seed burnt by grass-fires gives good results and in dry areas, sowing seed in contour lines and digging up soil under seedling trees helps.

1050 **Teak in Burma**. Indian Forester 36(3), 1910: 126-132.

More uniform system for teak combined with improvement fellings, based on Burma experience and on the aim and object of the method of working teak forests and methods of regeneration to be adopted are discussed.

1051 **Teak in Burma**. Indian Forester 36(11/12), 1910: 672-675.

The problem of yield and exploitation in the Burma improvement felling system are discussed with reference to natural regeneration of teak forests in Burma - with special reference to training labour for improvement fellings.

1052 **Teak in Trinidad**. Indian Forester 43(3), 1917: 161-162.

Tracing back the earlier introductions of teak in Trinidad to 1913 it was observed that best results were obtained in Central Reserve plantations. Seed source was Burma. Areas of teak planted, methods of planting and growth data under exotic conditions were also noted.

1053 ***Tectona grandis* (aspects of forestry in Indonesia)**. (Dutch). Tectona 43(3), 1955: 158-235.

The final issue of Tectona includes a series of general papers as well as the paper teak forests (W.A. Zijp).

1054 **Special issue on problems of the ecology of tropical forests**. Holz Aktuell 3, 1981: 96p .

Various aspects of the ecological problems of tropical forests are discussed. And also included a paper on teak. Burma: Its forests and teak timber. How it was possible to export wood for over 100 years without exhausting supplies: 62-65.

1055 **Forest ecosystems of the world**, 1992: 214p. Rawat Publications, Jaipur.

An examination of various aspects of forest ecosystems in different parts of the world in the context of the large-scale destruction and degradation of forests that is taking place worldwide. And also included a chapter on Teak [*Tectona grandis*] forests of India (Dube, R.S; Soni, P): 66-80.

1056 Altona, T. 1922. **The teak forests (*Tectona grandis* L.f.) in the Bismarck-Archipelago**. (Indonesian; English). Tectona 15: 862-869.

Discussed the pure teak forests in the midst of the mixed non-teak, local climate and soil not preferred by teak, supports that teak must have been imported to Bismarck-

Arhipelago. The origin is traced to colonist Hindoos.

1057 Altona, T. 1923. **Teak and Hindoos-Origin of *Tectona grandis* Linn.f. in Java**. (Indonesian; English). Tectona 16: 237-263.

Many teak forests in Java has been proved to be old plantations and that could not be proved to have been planted. These old forests were planted by Hindoos. The frequency of old teak plantations and the absence of virgin forests make it very improbable that the teak tree is native.

1058 Altona, T. 1926. **Teak and Hindoos-the legend of Adji-Saka**. (Indonesian; English). Tectona 19: 939-1011.

Evidence is presented to support the presumption teak tree has been imported and cultivated on the island of Java, Folklore and Vernacular names-'Tree from Java' suggest and confirm the import of teak in Boetom and Moena islands.

1059 Apichart Kaosa ard. 1981. **Teak (*Tectona grandis* Linn.f.) - its natural distribution and related factors**. Natural History Bulletin of the Siam Society 19: 55-74.

1060 Aung, D.U. 1956 . **Problem of invasive evergreen forests**. Proceedings of the 8th Silvicultural Conference, Dehra Dun, 1951, Part 2: 252-253.

Describes the development of Burmese moist deciduous teak-bearing forest to evergreen forest- a natural process accelerated by fire exclusion and selective teak working.

1061 Bhatt, R.P; Bedi, S.J; Sabnis, S.D. 1971. **Botanical exploration of the Gora range of the Rajpipla forests, Gujarat State**. Indian Forester 97(8): 477-486.

Lists 460 species found during three years of study. The vegetation is classified as mixed dry deciduous forest. *Tectona grandis* is the most important tree.

1062 Branca, A. 1960. **First experimental results of the introduction of forest tree species into Italian Somaliland 1954-1958**. Riv. Agric. Subtrop. Trop., Firenze 54(416-7/9): 652-660.

Short notes are included on teak and other species.

1063 Brandis, D. 1903. **Teak in evergreen forests**. Indian Forester 29(5): p187.

Describes teak in evergreen forests in Attaran, Burma, after an inspection tour with reference to and after reading Mr. Bruce's account of the patch of teak in moist evergreen forest in Ruby mines district and Mr. Ohver's remarks on it.

1064 Brascamp, E.H.B. 1915. **The teak in Rosengan**. (Dutch). Tectona 8: 73-74.

1065 Brascamp, E.H.B. 1916. **Teak in residency of Bantam**. Tectona 9: 707-709.

1066 Brascamp, E.H.B. 1921. **Teak and no Hindoos**. Tectona 14(8): 137-140.

Gives the origin of Tectona planting in Java which is attributed to Hindoos who imported the species into the area.

1067 Brascamp, E.H.B. 1922. **History of spreading of teak in Java in 1693, in Kolonial Archief No. XXXVIII**. Tectona 15: 951-959.

1068 Britto, S.J; Soosairaj, S; Arockiasamy, D.I. 2002. **Comparative analysis of distribution of tree species in two plots of one hectare in Srirangam Island of the river Cauvery**. Advances in Plant Sciences 15(1): 79-84.

The diversity, density and abundance of tree species 30 cm girth at breast height were investigated. Dominant species include teak.

1069 Bruinsma, A.E.J. 1916. **About the presence of teak forest in West-Java during East India Company**. (Indonesian; English). Tectona 9: 655-665.

1070 Canning, F. 1931. **Teak in the United Provinces**. Indian Forester 57(1): 4-5.

The author disagrees on the financial possibilities of introduction of teak in a sal predominant province. Even though, earlier plantations are successful, the author claims the policy of not replacing sal by teak, as success of teak introduced in gaps in sal forest is doubtful as no observations are made on teak growth till maturity.

1071 Carthaus, E. 1909. **Is teak originally native to the Malay Archipelago?** (German). Tectona 2: 309-319.

1072 Champion, H.G. 1938. **A preliminary survey of the forest types of India and Burma**. Indian Forest Records (n.s) Silviculture 1(1), 1936.

A classification of forest types based on four temperature zones, each sub-divided on available moisture reflected by the relative importance of evergreen, deciduous and thorny trees.

1073 Champion, H.G; Seth, S.K. 1968. **A revised survey of the forest types of India**. Government of India Press, Delhi: p404.

Includes an account of teak forest types under Moist Deciduous and Dry Deciduous types. *Tectona grandis* has been mentioned to occur as a characteristic species in the following types: South Indian moist deciduous very moist teak forests; South Indian moist deciduous slightly moist teak forest; Southern tropical dry deciduous very dry teak forest; Southern tropical dry deciduous dry teak forest.

1074 Chandrasekharan, C. 1962. **Forest types of Kerala state**. Indian Forester 88(9, 10, 11 and 12).

Includes an account of the forest types with detailed floristics including teak types.

1075 Chhetri, H.B; Rai, B; Basu, P.K. 1995. **Phytosociology and standing crop biomass of three different forest types of Namthang-Narak region (South Sikkim) under Teesta sub-catchment area**. Environment and Ecology 13(2): 304-308.

The results are reported of a phytosociological study made in three forest types in South Sikkim: natural tropical moist semi-evergreen forest, *Tectona grandis* plantation at 720 m altitude with 4200 tree stems/ha and *Shorea robusta* plantation.

1076 Chollet, A. 1967. **Teak in Africa**. Teak sub-Commission, FAO, Rome FO:T-67/3: 9p.

The origin of teak in Africa is described and the countries from where the species has been introduced have been listed indicating the areas covered. References of teak to climate and soil, tending operations required, diseases to which it is subjected are indicated. New developments in silvicultural treatment particularly as regards thinning and length of rotation are noted. The future potential of this species is summed up.

1077 Deb, D.B. 1960. **Forest type studies in Manipur**. Indian Forester 86(2): 94-111.

This is the first attempt to identify and classify forest types in this region. The main climatic zones with their respective formations are described which include *Tectona/Dipterocarpus* forests.

1078 Devois, J. 1959. **The teak (*Tectona grandis*) in tropical French Africa**. Cashiers des Ingen Agronomy 133: 9-14.

Deals with *Tectona grandis* on resources, culture and uses.

1079 Devoto, F.E. 1942. **Teak**. (Spanish). Mundo Maderero 3(25): 5-7.

Tectona grandis was introduced by the author to Argentine in 1929. Ten-year-old trees grown in the Satta province from seed obtained in British India have shown good growth and have fruited from the age of six years.

1080 Dubreuil, J. 1961. **The introduction of exotic species into Togo**. Proceedings of the 2nd Conference of Forestry Inter-African Countries, Pointe Noire, 1958 Vol. 2: 515-522.

Gives results of experiments with different exotic species including *Tectona grandis*. Teak was first introduced by the Germans at the beginning of the century.

1081 Forest Department, Sri Lanka. 1921. **Attempts to grow teak in Ceylon**. Government Publication, Ceylon: 15p. Forest Department, Sri Lanka.

1082 Forest Department, Tongo. 1960. **Forestry in Tongo**. Forest Advances Newsletter, Colonial Office, London: 8 Appendix A(1). Forest Department, Tongo.

Tongo's 27000 acres of forest, the bulk of which is on the island of Eua. Teak has recently been introduced on an experimental basis.

1083 Forest Department, Thailand. 1962. **Types of forests of Thailand**. Ministry of Agriculture, Bangkok R.44: 12p. Forest Department, Thailand.

Describes teak forests occurring predominantly in mixed deciduous forests in Northern Thailand.

1084 Forest Research Institute, Dehra Dun. 1923. **Ecology of teak**. Report of Forest Research Institute, Dehra Dun: 40p.

1085 Ganapathy, P.M. 1962. **Arborescent exotics in the forestry of Andaman Islands**. Golden Jubilee Souvenir 1912-1962, Southern Forest Rangers College, Coimbatore: 114-123.

Sketches the history, development and present status of exotics in Andaman Islands, where exotics, chiefly teak, are being substituted for the indigenous deciduous and semi-evergreen species.

1086 Ganeshaiah, K.N; Shaanker, R.U; Bawa, K.S (Editors). 2001. **Tropical forests: Structure,**

diversity and function - part B. Tree diversity and phenology. Tropical ecosystem: Structure, diversity and human welfare. Proceedings of the International Conference on Tropical Ecosystems: Structure, Diversity and Human Welfare, Bangalore, 15-18 July 2001: 737-777. Science Publishers, Enfield.

Out of ten papers one paper was on ecological adaptations and population structure in *Tectona grandis* in relation to seed production and tree breeding.

1087 Gent, J.R.P. 1927. ***Tectona grandis* in the Gold Coast**. Empire Forestry Journal 6: p292.

1088 Hertling, J.C.von. 1879. **Notes on *Tectona grandis* in Java**. Forstw Cbl 23: 486-490.

1089 Hewetson, C.E. 1941. **Observations on the ecology of *Tectona grandis* in the Central Provinces**. Indian Forester 67: 617-629.

The main points of the ecology of teak in the Central Provinces are discussed and suggestions are made for establishment of teak in this area.

1090 Hewetson, C.E. 1951. **Ecology of *Tectona grandis***. Madras Forest College Magazine 27(3): 101-108.

1091 Higo, Y. 1961. **On the introduction of forest tree species in the Meiji era**. (Japanese; English). Bulletin of the Faculty of Agriculture, Kagoshima University 10: 42-67.

Lists the species experimentally introduced from 1868 to 1912 with their Latin names and references to Japanese literature. Teak, eucalypts and *Albizia lebbek* are recommended for Formosa.

1092 Ilorkar, V.M; Khatri, P.K. 2003. **Phytosociological study of Navegaon National Park (Maharashtra)**. Indian Forester 129(3): 377-387.

The measurement of different phytosociological attributes like density, basal area, importance value index, nature of vegetation, distribution pattern and resource utilization of woody vegetation was conducted in the forest of Navegaon National Park in Maharashtra. *Tectona grandis* was the dominant species in the area.

1093 Indian Botanical Society, Baroda. 1955. **Symposium on vegetation types of India, 2-3 January 1955**. Indian Botanical Society, Baroda: 17p.

Gives abstracts of twenty eight papers, mostly dealing with the general vegetation of different areas, including discussions on the ecology of sal and teak and the ecological status of grasslands.

1094 Jackson, J.K. 1960. **The introduction of exotic trees into the Sudan**. Sudan Silva 10(1): 14-30.

Includes notes on teak.

1095 Kermani, W.A. 1951. **Exotic trees in East Pakistan**. Pakistan Journal of Forestry 1(3): 273-279.

Noted the performance of different exotic trees including *Tectona grandis*.

1096 Koppen, Karl van. 2003. **Transformation of tropical forestry starts with teak**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

It is argued that transformation of tropical forestry starts only with teak by discussing new dimensions of the giant leap towards global thinking, new limitations for the human behaviour, new issues of growing population and role of tropical forestry. New perspectives of tropical forestry were further elaborated considering teak as the flagship of tropical hardwoods for throwing light on the potential of sustainable investments, today's practices and benefits from such investments.

1097 Kriek, W. 1970. **Report to the government of Uganda on performance of indigenous and exotic trees in species trials**. Technical Assistance Report FAO/TA-2826.

1098 Krishna Murthy, A.V.R.G. 1960. **Forest types of Andhra Pradesh: India**. AIFC, Diploma in Forestry. Forest Research Institute and College, Dehra Dun.

A general account is given of the forest types of Andhra Pradesh with notes on climate, geology, soils and detailed description of ecological relationships of the various forests types. The teak forests of the state under the dry deciduous and moist deciduous formations are described in detail with ecology and floristics.

1099 Kuruvilla, K. 1967. **Ecology of Dangs Forest (Gujarat)-I. Phytosociology of the forests in Ahwa block**. Indian Forester 93(10): 720-733.

The ecological studies of the forest include the study of the pattern of distribution of various forest communities in relation to factors of topography, soil, microclimate and biota and assessing their ecological status. *Tectona grandis* is the dominant species in all the stands examined.

1100 Lane, D.A. 1958. **The planting of exotic trees in Ghana**. Proceedings of the 2nd Conference, Inter-Africa, Pointe Noire, 1958, Vol.2: 421-435.

Deals with different species including *Tectona grandis* and lists a number of other species that have been tried.

1101 Lavrov, M.T. 1965. **Forests and animals of North Vietnam**. (Russian). Izdatel'stvo Lesnaja Promyslennost, Moscow: 133p.

A compilation of information on the forests and fauna of North Vietnam, based on extensive travels in the country and on Russian, French and Vietnamese literature. The main types of forest vegetation are described. The chapter on forestry and the forest industry covers forest areas and volumes, felling, transport, plantations including *Tectona grandis*, nurseries, tending, conversion, harmful and useful insects, insect pest control, fire protection and hunting.

1102 Ledoux, P. 1963 . ***Tectona grandis* introduced into Mazagao, Amapa, began to flower at the age of 9 years**. (French). Lecointea, Belem 1: 8p .

Reported the flowering of one of the three biggest trees out of approximately 30 had a diameter at breast height of approximately 50 cm. and the tallest was 12 m. high.

1103 Loetsch, F. 1958. **The teak forests of northern Thailand**. World Crops 10(1): 13-16.

The description of the author's mission, the forest types encountered, total stock of main species, drain and regeneration, development trends etc., stressing the dangers of illicit cutting and shifting cultivation.

1104 Mathur, C.M. 1959. **Teak forests in Rajasthan and their problems**. Proceedings of All-India Teak Study Tour and Symposium, December 1957-January 1958: 172-175. Forest Research Institute, Dehra Dun.

Describes teak in Rajasthan state under the heads: Distribution, topography, geology and soil, climate, types of forests, condition of present crop, regeneration, defoliation and thinnings.

1105 Mathur, C.M. 1960. **Forest types of Rajasthan**. Indian Forester 86(12): 734-739.

The important types are dry teak and *Anogeissus pendula* forest.

1106 Meher Homji, V.M. 1970. **Some phytogeographic aspects of Rajasthan, India**. Vegetation 21(4/6): 9299-9320.

Analyses the floristic elements in each vegetation type, concluding that the boundary of the dry deciduous teak forest type should be regarded as the demarcation line between the Indo-Malayan and the Perso-Arabian floras.

1107 Mello, H do Amaral. 1962. **Some aspects of the introduction of teak into Brazil**. UNCSAT Conference, United Nations, Geneva E/CONF.39/C/475: 3p.

Describes preliminary results of teak cultivation in Piracicaba. Information on its growth and nursery methods is provided.

1108 Mello, H do Amaral. 1963. **The introduction of teak into Brazil**. (Portuguese). An bras. Econ. flor., Inst. Nac. Pinho 15: 113-119.

Gives preliminary results of attempts to establish a teak plantation in Piracicaba.

1109 Mensbruge, G de la. 1958. **The introduction of *Tectona grandis* in the Ivory Coast**. Inter-African Forestry Conference, Pointe Noire, 1958: 12p.

General history and notes on climate, natural regeneration, enemies, height, diameter and volume increment, methods of treatment, site factors, methods of formation and their cost.

1110 Milward, R.C. 1930. **The introduction of teak in United Provinces**. Indian Forester 56(12): 545-547; 57(1): 3-4.

Offers the views on growth of teak and regeneration in United Provinces and compares it with sal and yield of first class timber from teak growing areas comparing it with that of Burma.

1111 Mirchandani, T.K. 1941. **Kanara forests**. Indian Forester 67: 62-67.

Forests cover nearly four-fifths of the Kanara District. There are three main forest types-the tropical rain forest, the teak-bearing, deciduous high forest and the deciduous pole forest. The management and products of these forests and methods of exploitation are discussed briefly.

1112 Misra, R (Ed). 1957. **Vegetation types of India: Summaries of papers of the Symposium, Indian Science Congress, 1955**. Journal of Indian Botanical Society 36(4): 587-605.

Includes a number of papers on the vegetation types of India which also include a paper entitled teak bearing forests of Madhya Pradesh.

1113 Nina Mindawati; Sukaesih Parajadinata. 1997. **Development prospects of Malabar teak in Indonesia**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 24-27. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Malabar teak, introduced from Nilambur, Kerala, has been planted since 1932 in different locations in Indonesia for studying the growth characteristics. It is found that Malabar teak grows better in height and girth than local teak. The seeds give highest germination percentage of 56.81 than those of other local and exotic provenances. Wood quality of 40 year-old vegetatively propagated and seed propagated Malabar teak is same as that of local teak.

1114 Nisbet, J. 1892. **Notes on teak in Burma**. Forstl. Naturw. Zeitschr 1: 437-439.

1115 Oever, H.Ten. 1916. **Teak forests in Java**. Tectona 9: 851-878; 723.

1116 Ogbe, G.A.E. 1960. **A study of the introduction of three exotic trees to the Western region of Nigeria: *Tectona grandis* Linn.f. (Teak), *Gmelina arborea* Roxb, *Pinus caribaea*, Morelet (Slash Pine)**. Imperial Forestry Institute, Oxford: 121p.

Details of silvicultural and economic potentialities of exotic timber species including teak are presented. The necessity for cultivating economic timbers of very short rotation that can be grown on soils not required for agriculture is stressed. The soils and climate of the region are discussed. Data are given of volume and yield tables and curves for height, espacement and number of trees per acre are given.

1117 Oliver, J.W. 1905. **Teak in evergreen forest**. Indian Forester 31(7): p417.

Reported a patch of teak noted in the evergreen forest with an undergrowth of evergreen trees, plantains and palms in the Mohnyin Reserve, Katha Division and the teak reproduction is not possible in such forests.

1118 Pandeya, S.C. 1954. **Ecology of teak (*Tectona grandis*)**. Perugia University studi. Facol. Di. Agricultural Annals 10: 239-241.

1119 Parde, J. 2002. **Teak, in tropical forests and plantations**. (French). Revue Forestiere Francaise 54(3): 253-258.

Brief review of recent important publications on teak, Bois et Forets des Tropiques, 261/262/263, 1999-2000; Unasylva 201(2), 2000 and three other French articles. It describes the geographical distribution of the species and its silvicultural characters.

1120 Pedroso, L.M. 1973. **Information on the present behaviour of exotic species in the region of the middle Amazon**. Sudam Documenta 5(1/4): 21-31.

Data are presented on species trials with various exotics including teak to provide information on the probable growth of these species in the middle and lower Amazon region.

1121 Peet, C. 1954. **Famous forests: *Tectona grandis* in Burma**. American Forester 60(6): 20-21, p40.

1122 Puri, G.S. 1951. **Advances in the ecology of teak (*Tectona grandis*) in India**. Proceedings of the 8th Silvicultural Conference, Dehra Dun, 5-14 December 1951, Part II: 242-250.

Discussed the relationship of teak with its environment and the importance of such studies in scientific management of teak forests and in extending plantations of teak.

1123 Rance, W; Monteuuis, O. 2004. **Teak in Tanzania: I. Overview of the context**. Bois et Forests des Tropiques 279: 5-10.

This paper reviews the status of the existing teak stands monitored by the Tanzanian National Tree Seed Programme, which set up the Kiroka teak clonal seed orchard in the rural district of Morogoro in 1996.

1124 Rasmihiran, W. 1956. **Teak forests**. Vanasarn 14(4): 12-25.

Describes the condition of an evergreen forest in North East Thailand which has deteriorated due to overexploitation and smuggling and recommends improving the same by planting with teak.

1125 Rittirangsrirot, Ch. 1968. **The structural characteristics of teak bearing mixed de-**

ciduous forest, Huay-Tak, Ngao, Lampang. (Thai). Student Thesis. Kasetsart University, Bangkok.

Soils of more than 60 cm. deep are more fertile except in places where sandy-clay loam and clay-loam soils are derived from parent material of limestone or shale. The upper layers are alkaline and lower below, the reaction is acidic in these soils. Average highest humidity 88.4 percent and lowest 36.9 percent.

1126 Rosevear, D.R. 1940. **Exotic trees in the Cameroons**. Nigerian Forester 1: 22-25.

Successfully acclimatized exotic species including teak.

1127 Ross, J.K; Moss, R.P. 1957 . **Exotic forest trees in the Western Region of Nigeria. Some notes on the soils of the Western Region with special reference to plantations of exotic trees**. Government Printer, Ibadan: 29p. Seventh British Commonwealth Forestry Conference, Australia and New Zealand, 1957.

Includes details on teak in the region.

1128 Schmulling. 1922. **Teak in Java**. Zeitschrift fur Forst. U-Jagdwesen 54: p760.

1129 Scott, C.W. 1946. **Forestry in Burma**. Journal of Oxford University Forestry Society 1: 24-34.

1130 Seth, S.K. 1960. **Progress report on teak forestry in India 1957/1959**. FAO Teak-Sub-Commission, Delhi FAO/TSC 60/2.4: 2p. FAO, Rome.

Reviews the progress of teak forestry in India and progress made under revision of teak yield tables, study of teak soils, foliar analysis of teak, phytosociological studies of teak forests, teak provenance trials, teak genetics, teak epidemiology, teak wood seasoning, chemistry of teak wood, composite wood tests with teak, and mechanical and physical properties of teak.

1131 Seth, S.K; Kaul, O.N. 1978. **Tropical forest ecosystems of India: The teak forests (as a case study of silviculture and management)**. Tropical Forest Ecosystems. A State of Knowledge Report, UNESCO/UNEP/FAO, UNESCO, Paris: 628-640.

Ecosystem functioning of the teak forests is discussed under the following headings. Flowering and seed production, seed origins and provenances, germinative capacity and establishment, seed dormancy and pre-treatment, biomass and productivity, water balance, nutrient cycling and protection. Its natural regeneration, regeneration techniques and management practices are also discussed.

1132 Seth, S.K; Khan, M.A.W; Gupta, A.C. 1959. **Proposed programme for physiologico-ecological studies on teak**. Proceedings of All India Teak Study Tour and Symposium, Dehra Dun, 1959: 138-141.

The paper outlines the methods suggested for carrying out physiologico-ecological research on teak by three agencies namely FRI, Dehra Dun, State Forest Departments and state silviculturist.

1133 Setten, G.G.K. 1960. **Progress report on teak forestry in Malaya 1957/1959**. Teak Sub-Commission, New Delhi FAO/TSC-60/2.6: 1p.

Progress report since the first session of TSC in 1956 at Bangkok and reports the small scale planting trials initiated at Kedah in N.W. Malaya, FAO teak provenance trials and wilt attack in teak nurseries causing causalities of the nursery seedlings are reported.

1134 Shah, S.A. 1994. **Ecological aspects of tropical forest management (the case of India)**. Indian Forester 120(11): 981-999.

An account of the history of the development of forest management in India and discusses the ecological impacts of the different phases, covering effects on soil, water, wildlife and agriculture. Planting failures of commercial timber species mostly teak and loss of species diversity in teak forests are discussed.

1135 Singh, P; Oommachan, M. 1991. **Distributional range of trees of Jabalpur Forest Division, M.P**. Indian Journal of Applied and Pure Biology 6(2): 133-138.

A systematic study was made of the tree species present in the dry tropical forests of Jabalpur Forest Division, Madhya Pradesh. Two type of forests are identified, northern tropical dry deciduous forest typified by sal and southern tropical dry deciduous forest typified by teak.

1136 Soest, G.H van. 1869. **Forestry in Java**. Journal of the Netherlands East Indies: 151p.

1137 Stebbing, E.P. **The forests of India**. Government of India Press, Calcutta III: p415.

Gives notes on teak in Vol.III, p415.

1138 Stebbing, E.P. 1948. **The teak forests of Burma**. Indian Forester 74: 1-4.

Discussed the history of Burmese forests and their exploitation from 1852-1947, with a warning on future Burmese responsibilities. The author mentions about the working plan drawn up for Burma forests and in 1938-39 alone 1.4 million cu.ft. of teak timber was cut from 200 mission acres of reserved forests.

1139 Streets, R.J. 1962. **Exotic forest trees in the British Commonwealth**. Clarendon Press, Oxford: 712-725p.

The species introduction in Ceylon, Australia, Fiji, Ghana, India, Andamans, Jamaica, Kenya, Nigeria, Malaya, North Borneo, Nyasaland, Siorre Leone, Solomon Islands, Southern Rhodesia, Tanganyika, Trinidad and Tobago, Uganda, etc. were described including a note on pests and diseases and growth and yields in some plantations.

1140 Teak Sub-Commission, Indonesia. 1957. **Reports on teak grown under exotic conditions**. Teak Sub-Commission, Bandung, Indonesia FAO/TSC-57/3: 98p.

Furnishes information on growing teak under exotic conditions in Africa: Lower Guinea, Casa manea, Ghana-Gold Coast, Ivory Coast, Kenya-East Africa; in Asia and the Pacific: Australia-Papua and New Guinea, Ceylon, Fiji, Ryukyu Islands, Taiwan and U.S. Pacific Islands; in India: U.P., West Bengal; and Vietnam and Central America: Cuba, Jamaica, Panama, Puerto Rico, Surinam and Trinidad.

1141 Teak Sub-Commission, Rome. 1967. **Trials of teak in North West Malaya**. Teak Sub-Commission, Rome: 12p.

Afforestation work aimed at providing high quality cabinet timber is described. The rate of growth is compared and problem of borer attack discussed. No significant variation in form, vigour etc. of the various provenances of teak tried has been observed. Further trials adequately replicated with special reference to resistance to borer attack recommended.

1142 TEAKNET. 1995. **Major teak resources of the Asia-Pacific region**. TEAKNET Newsletter 1: p7.

1143 Tewari, D.N. 1967. **Ecological studies in Indian forests-trend of natural succession under treatment and closure in forest of Madhya Pradesh**. Proceedings of the 11th Silvicultural Conference, Dehra Dun 1967. Forest Research Institute, Dehra Dun.

The main forest types in the state mainly teak and sal are subjected to a variety and degrees of biotic influences, like grazing, fires and cuttings etc. The response to these factors was studied under the above treatments and closures. Suggestions are made for the scientific management of Madhya Pradesh forests.

1144 Thomas, R. 1941. **Forests and forest exploitation in the Congo: Deforestation, erosion and reforestation**. Bulletin Agricole du Congo, Belge 32: 91-111p.

About 48 to 53.5 percent of Congo lands are wooded. The distribution of various forest areas is given along with floristics and composition of tropical types. Besides native species, teak along with many other species has been tried.

1145 Tuteja, S.C; Singh, V. 1980. **The botany of Shespur forest division of Madhya Pradesh. I. Geology and forest types**. Indian Journal of Forestry 3(1): 9-14.

Seven major forest types were recognized including very dry teak forests.

1146 Ugalde Arias, L.A; Martinez, H.H.A. 1989. **Location and description of experimental sites for the 14 most important species in the Madelena Project in Central America**. (Spanish). 62p. Centro Agronomico Tropical de Investigacion y Ensenanza, Turrialba, Costa Rica Centro Agronomico Tropical de Investigacion y Ensenanza, Turrialba, Costa Rica.

Species include *Tectona grandis*.

1147 Vidal, J. 1960. **The forests of Laos**. (Spanish). Bois et Forests des Tropiques 70: 5-21.

Distinguishes and describes the forest types including the teak forests of Laos.

1148 Weaver, P.L; Francis, J.K. 1988. **Growth of teak, mahogany and Spanish cedar on St. Croix, U.S. Virgin Islands**. Turrialba 38(4): 308-317.

Included the data regarding the growth performance of teak. Testing of six provenances of teak showed significant differences in diameter at breast height and height with the Tamil Nadu, India, provenance growing most rapidly but having the highest mortality.

1149 White, K.J. 1967. **Teak as an exotic plantation species in Territory of Papua and New Guinea**. FAO Teak Sub-Commission: 7p.

Giving areas of teak plantation in Papua and New Guinea as 2997 ac. with an annual future programme of 400 ac. Observations are made on site factors, stocking yield, seed supply and thinnings and tree improvement trials.

1150 Yadav, S.S; Shah, G.L. 1982. **Phytosociological studies on the vegetation of Dangs Forest in south Gujarat: An ordination study of fourteen localities**. Indian Journal of Forestry 5(4): 281-286.

Maturity indexes, community coefficients and ordination values are given for each locality in this forest dominated by *Tectona grandis*.

1151 Zizp, W.A. 1955. **Teak forests**. Tectona 43: 169-179.

1152 Zwart, W. 1927. **True and false Bladong forests**. Tectona 17.

Go top

Vegetation Ecology

1153 Meher Homji, V.M. 1977. **History of the dry deciduous forests of western and central India**. Ecology and archaeology of western India: 109-126. D.P. Agarwal; B.M. Pande, Eds. Concept Publishing, Delhi.

The dry deciduous forests of Gujarat and Rajasthan, India are divided into seven types which include dry deciduous teak forests.

1154 Meher Homji, V.M. 1988 . **Vegetation of South India**. Advances in Forestry Research in India 2: 199-210.

A brief description is given of the small-scale vegetation maps published by the French Institute in Pondicherry in collaboration with the Indian Council of Agricultural Research. Maps on the medium scale of 1: 250 000 have been published in cooperation with the Forest Departments of Karnataka and Kerala. A classification of the vegetation in southern India has been proposed, based on 'series'. Five series are described in the paper, and the descriptions include information on climate, soil and land use. The series include moist deciduous teak forest series forming an ecotone between the wet evergreen forest series and the dry deciduous teak forest series on the western side of the Western Ghats in Kerala, Goa and Maharashtra, and on the eastern fringe of the Western Ghats in Karnataka, extending to 1000 m altitude and the dry deciduous teak forest series. The history of Indian forest vegetation is briefly discussed.

1155 Pande, P.K. 2001. **Structures of the tropical dry deciduous teak (*Tectona grandis*) forest of Satpura Plateau with special emphasis on regeneration and disturbance**. Journal of Tropical Forest Science 13(2): 329-343.

Comparative quantitative structures such as vegetation composition, structure and diversity and regeneration behaviours of important tree species were analysed on three sites in the tropical dry deciduous teak forest of South Chindwara Division, Madhya Pradesh. Three communities were identified: (1) *Tectona grandis-Lagerstroemia parviflora-Sterculia urens*, (2) *T. grandis-Lannea coromandelica-Diospyros melanoxylon-Butea monosperma-Miliusa tomentosa* and (3) *T. grandis-Chloroxylon swietenia-Lagerstroemia parviflora-Diospyros melanoxylon*. Stand density, species richness, diversity index, dominance, tree, shrub and herb composition were studied.

1156 Pande, P.K; Bisht, A.P.S; Sharma, S.C. 1988. **Comparative vegetation analysis of some plantation ecosystems**. Indian Forester 114(7): 379-389.

Phytosociological data are discussed for four plantations including *Tectona grandis* at New Forest, Dehra Dun, Uttar Pradesh, studied by quadrate analysis. Tree density and species richness were highest in the older plantations. Total basal cover is reported of teak 2887.27 eucalypts 1106.88. Importance value index was highest for eucalypts and sal followed by teak and pine in their respective plantations.

1157 Pandit, B.R; Raviya, R.D. 2001. **Phytosociological study of Eastern Gir forest**. Flora and Fauna Jhansi 7(1): 35-36.

An ecological survey of Gir forest in Gujarat was made. *Tectona grandis* was one of the most important and distinct species in the forest.

1158 Pradeepkumar, G; Prathapasenan, G. 2001. **Tree diversity of Shoolpaneshwar Wildlife Sanctuary in Gujarat**. Indian Forester 127(11): 1207-1214.

A detailed survey of the trees of Shoolpaneshwar Wildlife Sanctuary, Gujarat was conducted. The prominent forest type was a mix dry deciduous dominated by *Tectona grandis*. The major threats to the natural vegetation and its components are presented.

1159 Prasad, R; Pandey, R.K. 1992. **An observation on plant diversity of sal and teak forests in relation to intensity of biotic impact at various distances from habitation in Madhya Pradesh: A case study**. Journal of Tropical Forestry 8(1): 62-83.

A study on the extent of biotic impacts on natural forests was conducted about 0.5-1 km from villages (site 1), about 5 km from villages (site II) and 5-10 km from villages (site III). Sets of sites were chosen in the sal forests of Mandla and Bilaspur districts and the teak forests of Seoni and Balaghat districts. Phytosociological characteristics, regeneration status and successional trends were studied in all the sites.

1160 Sai, V.S; Budholiya, S.S. 1986. **Niche measurement of tree species in a central India forest**. Tropical Ecology 27(1): 76-84.

Studies on niche measurement were conducted for tree species occurring at two forest sites, namely N. and S. facing slopes of the Chhuhiya hills on the Kymore range of the Vindhya mountains, Madhya Pradesh. Forest type was tropical dry deciduous dominated by *Tectona grandis* and *Shorea robusta*. Measurement of niche breadth and overlap based on species composition at different altitudes was made by absolute and resource weighting measurements.

1161 Santapau, H; Raizada, M.B. 1954. **Contributions to the flora of the Gir forest in Saurashtra**. Indian Forester 80(7): 379-389.

Teak is the main forest tree species which often becomes crooked due to maltreatment. Other species occurring are listed. New plantations of teak, semai, and maddi are coming up.

1162 Shah, G.L; Bhatt, R.G. 1980. **Phytosociology of the forests of Panchmahals district in eastern Gujarat**. Indian Journal of Forestry 3(1): 47-53.

Vegetation data are tabulated for 11 forest districts in the area, the dominant community includes Tectona. Data are compared with those from the neighboring Chhotaudepur Forest Division.

1163 Shah, G.L; Yadav, S.S; Parabia, M.H. 1978. **Phytosociological studies on the vegetation of Chhotaudepur forest division, Eastern Gujarat**. Indian Journal of Forestry 1(4): 312-318.

Frequency data of species are tabulated for five ranges and for the division as a whole. The dominant community includes *Tectona grandis* with an understorey of *Holarrhena antidysenterica*.

1164 Singh, J; George, M; Varghese, G. 1988. **Vegetation communities and interspecific association of the tree species in a tropical forest ecosystem of Western Ghats**. Journal of Tropical Forestry 4(3): 229-235.

Vegetation analysis of the Mudumalai wildlife sanctuary in Tamil Nadu shows *Terminalia tomentosa*/*Lagerstroemia microcarpa* (moist deciduous), *Tectona grandis* /*Anogeissus latifolia* (dry deciduous) and *A. latifolia/Acacia chundra* (dry deciduous). The communities were mapped and their distribution correlated with the rainfall pattern of Mudumalai Forest Division.

1165 Singh, V.P; Dagar, J.C; Upadhyaya, S.D. 1979. **Analysis of structure, production dynamics and successional trends of tropical grassland communities at Ujjain**. Sylvatrop 4(4): 231-254.

It is suggested that the grasslands represent a seral stage maintained by grazing, burning and harvesting and in the absence of these controls succession would occur to a dry deciduous forest dominated by Acacia spp., *Butea monosperma* and *Tectona grandis*.

1166 Smitinand, T. 1994 . **Measuring and monitoring biodiversity in tropical and temperate forests: Proceedings of a IUFRO Symposium, Chiang Mai, Thailand, 27 August-2 September 1994**. 395p. Center for International Forestry Research, Jakarta, Malaysia.

This book contains 24 papers selected from among those presented at the symposium. A paper on genetic diversity of *Tectona grandis* is also included.

Go top

Silviculture

(See also 0152)

1167 **Teak**. Indian Forester 8, 1882: 240-243.

A note on growing teak in Coorg and geographic distribution, locality factors, growth rates, and requirements of growth, seed germination and planting problems and experience gained in growing teak so far is given.

1168 **Autobiography of a teak tree: Extract from Madras Mail**. Indian Forester 17, 1891: 240-244.

Covers the silvicultural characteristics and uses of teak wood in a lighter vien.

1169 **Java teak**. Indian Forester 40(9), 1914: p468.

Teak forests in Java occupy 148,000 acre and every year 2.5 times area felled is regenerated. Sowings of *Leucaena glauca* in between rows keeps down Imperata grass and keeps soil clean, enriches the soil in humus and nitrogen and ultimately disappears with the increase of the forest cover.

1170 **Teak in Burma**. Indian Forester 40(9), 1914: 450-451.

Describing the silvicultural requirements of teak, the author advocates artificial sowing of teak in lines in mixture with Pyinkado or some other shade tree and reports that the present selection system is unsuitable for teak. Pure species groups are preferred to mixed groups and advocates stocking of bamboo flowered areas artificially. Two storied high forest systems and thinnings of plantations are recommended.

1171 **India: Resolutions passed at the Sixth Silvicultural and the Senior Officers' Conferences, Dehra Dun, April 1945**. Empire Forestry Journal 24(2), 1945: 214-220.

Resolutions were passed on post-war silvicultural research, the effect of war on silvicultural and yield prescriptions of working plans, the efficiency of enumerations, natural and artificial regeneration of teak, the afforestation of dry areas, grazing and pasture research.

1172 **Silvicultural research: Ceylon 1944**. Office of the Conservator of Forests, Colombo, Ceylon, 1946: 16p.

Teak sample plots of the Eastern division, which have a rank growth of *Imperata cylindrica* are subjected to annual ground fires which tend to increase erosion, and the Illuk itself has a markedly debilitating effect on the teak. These effects become more pronounced when thinnings are carried out in plantations which had previously been underthinned.

1173 **Recommendations of the all-India Teak study tour and symposium, December 1957-January 1958**. Indian Forester 84(10), 1958: 593-602.

Recommendations are made for the regeneration, tending and management of the different types of teak forest and plantation.

1174 **The silviculture of teak-Republic of Dahomey**. (French). Centre Technique Forestier Tropical Publication, 1969: 40p.

Gives an account of silviculture of teak in the Republic of Dahomey with a detailed description of soils and conditions favourable for teak plantations. Results of the analysis of soils and density and stocking of plantations raised during 1950-1968 are appended.

1175 Ali, S. 1970. **The silvics and silviculture of teak**. Pakistan Journal of Forestry 20(2): 163-169.

1176 Aung, T; Aung, H; Mon, A.A. 2001. **Variation in the quality-wise ratio of teak logs of export quality production during the last decade from 1990-91 to 1999-2000**. Academy of Agriculture, Forestry, Livestock and Fishery Sciences, Research Paper: 11-12.

1177 Becking, J.H. 1928. **Silviculture of teak in Java**. (Indonesian; English). Meded Proefsta Boschw 22.

Reports experiments set up to compare the value of crops raised from advance growth supplemented by sowing under girdled trees and some coppice, with plantations raised with field crops. The treatment is described and the results showed that there was little difference between the two crops as regards increment, but the plantation teak was said to be slightly of better form.

1178 Best, J.W. 1918. **Silviculture in the Central Provinces from the tax prayers' point of view**. Indian Forester 44(9): 401-409.

Some measurements of yield from teak forests of Hoshangabad Division are given.

1179 Brascamp, E.H.B. 1916. **The end of teak in Rosengan**. Tectona 9: p318.

1180 Chandrasekharan, C. 1959. ***Tectona grandis* recent research trends at Nilambur**. Proceedings of All India Study Tour and Symposium, December 1957-January 1958, Forest Research Institute, Dehra Dun, 1959: p189.

Deals with several aspects of research on teak specially a new disease in teak, incidence of teak defoliation, deterioration of site

quality in second rotation, thinning research experiments, under planting etc.

1181 Chaplin, G.E. 1993. **Silvicultural manual for the Solomon Islands**. ODA Forestry Series 1: 305p. Overseas Development Administration, London.

This manual provides silvicultural accounts for the 14 most important tree species including teak in the Solomon Islands together with summaries for quick reference. It is complemented by the five volumes of the management manual, which provides basic directives for day-to-day practices. Bibliographies with more than 300 references are included.

1182 Chollet, A; Samapudhi, K. 1967. **Teak Sub-Commission. Fourth Session, Rome, 17 October 1967. Provisional agenda**. FAO Report T-67-1-8: 45p.

A collection of papers including, History and achievements of the Teak Sub-Commission; Teak in Africa; Teak as an exotic plantation species; Production outlook for teak in Burma; Production outlook in the old teak-growing countries and Country report on teak forestry, Thailand.

1183 Coster, C. 1933. **The application of the biological sciences to the problem of growing crops**. Proceedings of 5th Pacific Science Congress, Canada.

A review paper of research in Java on growth rings and their significance in the tropics; floral biology of teak, susceptibility of tree roots to oxygen, morphology of root systems, root competition, shoot growth of teak and germination of teak seed.

1184 Dupuy, B; Verhaegen, D. 1993. **Plantation-grown teak (*Tectona grandis*) in Cote d'Ivoire**. (French). Bois et Forests des Tropiques 235: 9-24.

A brief account is given of the research undertaken in the last twenty-five years, covering tree breeding, progeny trials, genetic improvement, provenance studies, nursery techniques, vegetative propagation, silvicultural treatments and wood properties of teak.

1185 FAO. 1960. **Report of the working party on silviculture and management**. FAO Teak Sub-Commission FAO/TSC-60/3.1: 6p.

As per the approved programme of work, specific detailed projects of priority are listed in participating countries and ad hoc projects of high priority mainly in Burma, Ceylon, India, Pakistan and Thailand are listed.

1186 FAO. 1967. **Teak as an exotic plantation species**. Asia-Pacific and African Forestry Commission, Teak Sub-Commission, Rome FAO T-67/5: 3p.

In India, plantations of teak occur outside natural range in states of Uttar Pradesh, West Bengal, Bihar, Assam and Union Territory of Andamans. Figures of growth and yield are given and practice of establishment, tending and thinning are described. On good sites teak is grown for timber on the rotation of 60-80 years while on poor soils its is grown on short rotation of 30-45 years for poles or small timber production.

1187 Farrer, R.P. 1960. **The first eight years on the ronds**. Empire Forest Review 39(1): 89-93.

Rondo-a small plateau of 2000-3000 ft. altitude in Southern Tanganeyike with *Cholorophora excelsa* as natural species in forest is described. The paper gives an account of introduction of teak and most dominant of successful introduction is 34 ft. at 7 years age.

1188 Forest Department, Fiji. 1943. **Notes on growing teak**. Annual Report, Forest Department, Fiji: 5p.

Brief notes are given on the growth characteristics and possible uses of *Tectona grandis* and other species, which have been planted on an experimental scale in Fiji.

1189 Forest Department, Nigeria. 1941. **On teak growing in Nigeria**. Annual Report, Forest Administration, Nigeria 1940: 14p. Forest Department, Nigeria.

Teak has been raised successfully from direct sowings.

1190 Forest Department, Trinidad and Tobago . 1939. **Progress report on teak planting in Trinidad and Tobago**. Annual Administration Report, Forest Department, Trinidad and Tobago, 1938.

Teak planting has proved successful in the past and it is planned to expand the project. Thinned teak stand can be successfully underplanted with Balata (*Mimusops balata* var. *cruegeri* Pierre). The burning of slash on nursery beds of a stiff clay soil prior to sowing with Cypre and Cedar resulted in better survival and health of the seedlings. Manurial treatment with Nicifos has a beneficial effect on chlorotic teak trees.

1191 Forest Department, Trinidad and Tobago. 1942. **Progress report on teak planting in Trinidad and Tobago**. Annual Administration Report, Forest Department, Trinidad and Tobago 1940/41. Forest Department, Trinidad and Tobago.

The heartwood of Trinidad grown teak was found to be distasteful to drywood termites.

1192 Forest Research Institute, Dehra Dun. 1960. **Proceedings of the Ninth Silvicultural Conference, Dehra Dun, 7, 10-19 December 1956. Part I**. Forest Research Institute, Dehra Dun: p409.

Contains seventy three papers including natural and artificial regeneration of teak.

1193 Forest Research Institute, Dehra Dun. 1966. **Proceedings of the Tenth Silvicultural Conference, Dehra Dun, 15-20 November and 22-25 November 1961. Volumes I and II**. Forest Research Institute and Colleges, Dehra Dun.

Papers on natural and artificial regeneration of sal, teak and other species are also included.

1194 Gilbert, G. 1927. **La sylviculture aux index-Netherlandaises**. Bulletin of Agriculture Congo Belge 20(4): 479-500.

Teak is regenerated by clear-felling existing crop and planting with stumps in combination with taungya culture or agri-silviculture. Other methods, include coppice with standards system, which affords soil protection and stand improvement; but this is inferior to growing mixed plantation with *Leucaena glauca*.

1195 Hardjodarsono, M.S. 1977. **Teak**. (Indonesian). 86p. Universitas Gajah Mada, Yogyakarta, Indonesia.

1196 Imam, S.A. 1969. **Silviculture and silvics of teak**. Forest Dale News 1(4): 49-61.

A brief review.

1197 Jhilmit, S. 1992. **Manual for the production of teak in Trinidad**. Forestry Division, Mimeo: 67p.

1198 Keita, J.D. 1964. **Teak at Bamako**. (Hebrew; French). La-Yaaran 14(4): 117-122; 132-137.

In a dry forest type with Isoberlinia doka stump plants of teak were planted. The area was weeded twice in the first dry season, dust-mulched at the end of the rains and cultivated groundnuts in the second year. The early growth data indicate that it should be possible to produce stems with approximately 10 m. of good bole.

1199 Keogh, R.M; Pentsil, M.Y. 2001. **Teak in Ghana, a best practice of field guide**. Forest Plantation Development Centre, Ghana.

1200 Kermode, C.W.D. 1957. **Teak-the silviculture of gregarious types**. FAO Forestry and Forest Products Studies 13 (Tropical Silviculture Vol.II): 168-178.

The occurrence of teak in various forests of Burma is described along with site factors. Observations are made on the silvics of teak (seedling habits, germination and growth habits), and management systems and silvicultural operations designed to induce or establish regeneration of teak, and the effect of bamboo flowering on natural regeneration are also discussed.

1201 Kinloch, D. 1945. **Silvicultural notes on some of the more important Gold Coast trees**. Government Printing Department, Accra: 70p.

The notes indicate certain silvicultural properties of twenty nine important indigenous species and a few exotics including *Tectona grandis*.

1202 Kushalappa, K.A. 1977. **Teak plantations in Thailand**. Indian Forester 103(5): 323-328.

A general account of management, seed collection, nursery practice, site preparation and labour is given. Regeneration is mainly artificial by planting stump plants, which are prepared in permanent nurseries. The creation of forest villages near the teak plantations has helped to ensure a more regular supply of labour.

1203 Kyi, Maung. 1962. **Silvicultural papers relating to teak in Africa**. UNCSAT Conference, United Nations, Geneva E/CONF 39 C/13, 45, 110, 206, 380: p6; 4; 8; 4; 5.

Includes the use of teak for forestry development in lower and middle Casamenca (Senagal).

1204 Lowe, R.G. 1973. **Silvicultural characteristics of trees in growth plots by pattern analysis and stand curve analysis on the electronic computer**. Federal Department of Forest Research, Nigeria, Forest Series, Research Paper 13: 14p.

Describes a method for assessing the silvicultural characteristics of growth plots and presents results obtained by its application to unthinned 0.4-acre plots, at several sites in the main forest zones of southern Nigeria. Comparison between different species on the same site, and the same species on different sites, is made by combining the results of pattern analysis and stand-curve analysis.

1205 Martinez, H.A; Robles, X. 1986. **Silviculture of various species of multipurpose trees**. (Spanish). Chasqui 12: 4-16.

Data are presented and discussed on the silvicultural characters, principal uses, site requirements, silviculture and growth of six species including *Tectona grandis* selected for growing in Central America by the CATIE/ROCAP fuelwood projects. A bibliography containing references for each species compiled by X. Robles is appended.

1206 Quint, M.P.L. 1957. **Report on teak in Dahomey - the silviculture of gregarious types**. Tropical Silviculture 2, (FAO Forestry and Forest Products Studies 13): 233-236.

Deals with teak in Dohomey under the heads manmade forest, geographic distribution, ecology, sowing, growth, silviculture and forest protection.

1207 Rao, V.S.J. 1959. **Teak in Andhra Pradesh**. Proceedings of All India Teak Study Tour and Symposium, December 1957-January 1958: 166-168. Forest Research Institute, Dehra Dun.

Notes on the occurrence of teak forests in Andhra Pradesh are included. Teak is regarded as a constituent species of the dry deciduous forests of Godavari and Krishna river valleys. 5 to 35 percentage of teak is reported in mixed forests. The status of natural regeneration in different forest managed under selection-cum-improvement, simple coppice and coppice with reserve system was discussed. The paper also contains a note on artificial regeneration of teak and local experiments on thinning.

1208 Rappard, F.W. 1961. **Teak in Netherlands, New Guinea**. Ned. New-Guinea 9(6): 10-11; p13; p15. Agricultural University, Wageningen.

It is suggested that one of the ways to prevent a shortage of building timbers in the future is to establish teak plantations near Meranke, South New Guinea where the monsoon climate favours the growth and health of such plantations.

1209 Roosendael, J van. 1935. **Setting out of teak**. Tectona 28: p954.

1210 Sagreiya, K.P. 1959. **Silviculture and management of the teak forests of Madhya Pradesh**. Proceedings of All India Teak Study Tour and Symposium, December 1957-January 1958, Dehra Dun: 69-72.

Management of dry and moist teak forests of Madhya Pradesh and its regeneration are discussed.

1211 Shukla, S.K. **Our trees - teak**. Intensive Agriculture 17(9): p28.

1212 Simmons, C.E. 1930. **Progress report of the forest research work in India for 1928-29, Chapter V**. Forest Research Institute, Progress Report: 156-158.

1213 Srijono, D.W. 1979. **Saving the simplisia in the teak forest**. (English; Indonesian). Duta Rimba 5(32): 3-6.

1214 Sukwong, S. 1979. **Six years of silvicultural system trials in demonstration teak forest of Lampang**. (Thai). Proceedings of the Forestry Conference, 20 November 1979, Bangkok: 111-119. Ministry of Agriculture and Cooperatives, Bangkok.

1215 Trevor, C.G. 1928. **Progress report of forest research work in India, 1926-27, Chapter V**. Government of India Press, Calcutta: p224.

Gives notes on the insect *Hapalia machaeralis*.

1216 Trivedi Babu, N.V. 1997. **Silviculture of teak with special reference to Kerala**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 7-14. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

In India, its natural zone of distribution is mostly confined to Peninsular region below 24 degree latitude. Teak thrives best in fairly moist-warm tropical climate. In Kerala, it extends up to an elevation of 1200 m in the Western Ghats, best growth is obtained at or below 600 m. Generally, teak prefers basic soils. It is a very strong light demander and appears to be extremely sensitive to drought, particularly in the first year. Stumps serve as the main source of propagule for artificial regeneration. Nursery, planting, and thinning techniques followed in the State and problems in pure as well as mixed teak plantation are discussed. Identifying suitable short rotation species for mixed planting, improving the vegetative propagation methods, investigating the limiting factors for the natural regeneration, etc. are aspects suggested for future research.

1217 Troup, R.S. 1921. **The silviculture of Indian trees**. Clarendon Press, Oxford: 697-798.

A complete record of knowledge and experience grained in India and Burma. The subjects covered are occurrence, distribution, ecology, botanical and silvicultural characters, silvicultural systems, protection and growth statistics.

1218 Ugalde Arias, L.A. 1997. **Results of 10 years of silvicultural research in the Madelena project in Honduras**. Serie Tecnica: Informe Tecnico Centro Agronomico Tropical de Investigacion y Ensenanza 288: 179p. Turrialba, Costa Rica.

An account of silviculture research on eight species in Honduras including *Tectona grandis* is given. The accounts cover botany, ecology, site requirements, characteristics and uses, silviculture, details of experimental field work and the results of growth studies.

1219 Ugalde Arias, L.A. 1997. **Results of 10 years of silvicultural research in the Madelena project in Costa Rica**. Serie Tecnica: Informe Tecnico Centro Agronomico Tropical de Investigacion y Ensenanza 290: 162p. Turrialba, Costa Rica.

An account of research on seven species including *Tectona grandis* in Costa Rica is given. The accounts cover botany, ecology, site requirements, characteristics and uses, silviculture, details of experimental field work and the results of growth studies.

1220 Ugalde Arias, L.A. 1997. **Results of 10 years of silvicultural research in the Madelena project in Nicaragua**. Serie Tecnica: Informe Tecnico Centro Agronomico Tropical de Investigacion y Ensenanza 292: 175p. Turrialba, Costa Rica.

An account is given of research on twenty two species including *Tectona grandis* in Panama. The accounts for these species cover botany, ecology, site requirements, characteristics and uses, silviculture, details of experimental field work and the results of growth studies.

1221 Ugalde Arias, L.A. 1997. **Results of 10 years of silvicultural research in the Madelena project in El Salvador**. Serie Tecnica: Informe Tecnico Centro Agronomico Tropical de Investigacion y Ensenanza 291: 189p. Turrialba, Costa Rica.

An account is given of research on eleven species including *Tectona grandis* in El Salvador. The accounts cover botany, ecology, site requirements, characteristics and uses, silviculture, details of experimental field work and the results of growth studies.

1222 Ugalde Arias, L.A. 1997. **Results of 10 years of silvicultural research in the Madelena project in Panama**. Serie Tecnica: Informe Tecnico Centro Agronomico Tropical de Investigacion y Ensenanza 293: 113p. Turrialba, Costa Rica.

An account is given of research on nine species including *Tectona grandis* in Panama. The accounts cover botany, ecology, site requirements, characteristics and uses, silviculture, details of experimental field work and the results of growth studies.

1223 Vallejo, A.P. 1977. ***Tectona grandis***. (Spanish). Forestal 1(6): 20-22.

A brief note on the silvicultural characteristics of *T. grandis* and on the behaviour of this species when introduced into various countries, including Puerto Rico, Venezuela and Trinidad.

1224 Vidal, M.P.H; Williams, G.H.D. 1956. **Teak as a plantation tree in Sudan**. Forestry Memoirs 8. Agricultural Publication Committee, Khartoum.

The oldest teak plantation is traced back to 1920. The provenance introduced is best without fluting. Teak is considered resistant to fire and suppresses grass hazard of fire. Faster growth, easy to raise in nursery, seed collection easy, stump planting and transport advantage, fairly hardy and drought tolerant, termite proof, best pole of hardwood and a ready sale of thinned produce are the advantages of growing teak plantation.

1225 Wycherley, P.R. 1966. **Teak problems in north Thailand**. Malaysian Forester 29(2): 64-68.

Silvicultural problems in natural regeneration of teak forests and reestablishment of teak after taungya cultivation in N. Thailand are discussed. The work of the Danish-Thai Teak Improvement Centre on the selection and propagation of superior trees is described.

1226 Zon, P van. 1955. ***Tectona* from beginning to the end**. Tectona 43: 236-239.

1227 Zuhaidi, A.Y; Zakaria, I; Rosdi, K; Krishnapillay, B. 2002. **Species for timber plantations**. A manual for forest plantation establishment in Malaysia: 13-24. Forest Research Institute Malaysia, Kuala Lumpur, Malaysia.

This paper describes the growth, distribution and ecology and associated pests and diseases of twelve species including teak suitable for forest plantations in Malaysia.

Go top

Regeneration and Formation of Stands

1228 **Effect of forest fires on reproduction in teak forests**. Indian Forester 8, 1882: 158-159.

The author attributes hollowness of Burma teak to jungle fires and suggests fires help to accelerate germination by attacking the close tough felty covering round the seed and the failure of twice-repeated sowings in Tharrawaddy and Porone districts might be avoided by mixing seed with dry grass and giving a light burn before rains.

1229 **Natural regeneration of teak under uniform methods**. Indian Forester 44(2), 1918: 87-88.

Reported the natural regeneration of teak obtained in the clear felled area of Aravillicava plantation, 1844.

1230 **Teak regeneration**. Indian Forester 48(7), 1922: 399-401.

The method of teak regeneration in Bombay Presidency is described by clear-felling and sowing. Treated or untreated teak seeds are dibbled in each patch marked by a stake. Seedlings thrice weeded during rains and mulched. The causes for failures of this method are infertile seed and poor soil aeration and recommends ploughing and sowing in furrows of 18" wide strips. On steep slopes transplanting small seedlings or root and shoot pruned larger seedlings are preferred.

1231 **Teak regeneration**. Indian Forester 54(4), 1928: 267-269.

The various methods of teak regeneration are listed and the author is of the opinion that variation in natural regeneration attributed from year to year is more due to climatic factors, than to fires or fertility of seed or opening of canopy.

1232 **Regeneration of teak from coppice and seedlings in U.P., India**. Forest Research in India, 1932: p88.

1233 **Forest research in India and Burma, 1939-40. Part I - The Forest Research Institute, Dehra Dun**. Manager of Publications, Delhi, 1941: 133p.

The effect of slash burning on artificial reproduction was found to vary with different species. It had a stimulating effect on stump plants of *Morus alba* and *Tectona grandis*. Analysis of soil samples indicated that burning and the application of ash have a marked effect in increasing the pH, while soils on which the slash was burned and the ash removed showed a relatively low value for nitrates.

1234 **On teak regeneration and slash burning**. Silviculturist's Report for Central Provinces and Berar for the year 1941: 9-10.

In a planting experiment with teak, the original high mixed forest was clear felled and the slash burnt preliminary to planting. In an area where the slash burn was intense the teak plants showed greater vigour than in an area where the burn was very light.

1235 **Annual report on silvicultural research in the Madras Presidency for the year 1939-40**. Superintendent, Government Press, Madras, 1941: 165p.

Stump planting is reported as the best method of artificial regeneration for *Tectona grandis*.

1236 **On factors effecting teak regeneration**. Aministrative Report, Forest Department, Central Provinces and Berar 31 March 1940: 38p. Government Printing Press, Nagpur, 1941.

Bamboo regrowth is considered as a serious obstacle to teak coppice in the moist type. This can be overcome by felling and burning the bamboo a year or so before the main fellings, cutting and regrowth with the tree crop, burning the felling debris and removing all bamboos interfering with teak coppice. In forests, where Lantana is an obstacle for teak regeneration, the burning of the shrub for three years in succession prior to main fellings appears to improve conditions.

1237 **Effect of gregarious flowering of bamboo on forest regeneration**. Forest Reserch Central Provinces and Berar 1947-48, 1948: 18p.

After gregarious flowering and death of bamboo *Dendrocalamus strictus* - profuse regeneration of teak and other tree species was observed. But it is observed that dense bamboo regeneration is likely to suppress the tree species.

1238 **Reforestation of poor land in the teak region**. (Dutch; Javanese). Rapp, Bosbouwproefsta. Buitenzorg 10, 1949: 12p .

By the application of phosphates soils can be improved, but results are not reliable; acid grasslands can be improved by cultivation for 1 to 2 years under agricultural crops. Tree species are recommended for the worst soils. The growth characteristics, volume production, diseases and pests, and economic uses of each species are discussed.

1239 **Natural regeneration of teak**. Forest Research in India Part II, 1950-51: p48. Forest Research in India and Burma, 1951.

The natural regeneration of teak is considered as a problem in moist high forests of Warla and Kathiawada ranges of Madhya Bharat. Where *Sorghum hopensis* and other miscellaneous species are a hindrance to natural regeneration and establishment of teak seedlings.

1240 **Artificial regeneration**. Forest Research India and Burma Part 1, 1955: 22-35.

Reports on a number of experiments on winter planting and use of split stumps of different species including *Tectona grandis*.

1241 **Artificial regeneration: Effect of planting split stumps as compared to normal stumps on survival and subsequent growth**. Forest Research in India and Burma 1950-51, Part I, 1955: 27-28.

Splitting into four stumps seems to be better than no splitting or splitting into two, and splitting into two is better than no splitting at all.

1242 **Natural regeneration by seed**. Forest Research in India Part II 1954-55, 1955: p72.

Preliminary observations in Madras state, indicate that a light ground fire in teak plantation induces and accelerates natural regeneration.

1243 **Regeneration experiments in Papua**. Australian Timber Journal 25(9), 1959: 41-56.

Describes a management programme begun by the Forest Service in 1954 for introducing different species including *Tectona grandis* into 1800 acres of the virgin rain forest of the Brown River Area of Papua. The best progress was made by *T. grandis*, *E. torrelliana* and *E. deglupta*, which are held to be the most suitable for replanting the cut-out rain forest on the better soil types.

1244 Ahmad, Y.S. 1951. **Will teak regenerate naturally in the Chittagong Hill Tracts**. Pakistan Journal of Forestry 1(3): 271-272.

Teak forests of 78 years old are ready for exploitation. An experimental area has been laid out, in which 1/4 of the trees will be removed every 3rd year. After each felling, all second-storey species of bamboos and shrubs, will be cut and burned by hoping that this treatment will help teak to regenerate naturally.

1245 Aiyar, M.R.S. 1917. **Concentrated regeneration of teak**. Indian Forester 43(4): 199-201.

Describes the experiments conducted in Takkadi leased forests of the Anamalai. In one plot bamboo was cut but area not burnt and the natural teak forest seed was dibbled without any treatment, in an area where trees are left standing and area is weeded four times. In second plot everything was cut, bamboo up-rooted, cut-material removed and without any burning teak seed dibbled and weeded. Best results got from the second plot.

1246 Allsop, F. 1947. **Natural regeneration of teak in Mong Mit forest division, Shan States, Burma**. Indian Forester 73(9): 399-400.

In some parts of this forest division there is much natural regeneration of teak, locally as dense as an ordinary plantation. The prescribed cleaning and thinning operations are described.

1247 Altona, T. 1928. **Teak regeneration in British India**. (Indonesian; English). Tectona 21: 629-645.

The regeneration practice is described in chronological order. The draw-backs in natural regeneration of teak are uneven seedling crop, slow growth, heavy weeding and tending costs. Planting under taungya is considered as the best method.

1248 Aung, D.U. 1949. **Natural regeneration of teak after gregarious flowering of *Bambusa polymorpha***. United Nations Scientific Conference on the Conservation and Utilisation

of Resources, Lake Success, 1949. U.N.S.C.C.U.R, Lake Success, USA.

After bamboo flowering teak seedlings, even though suppressed by weeds, may survive and establish when the top-canopy is lightened, and the young crop is assisted by weeding and improvement fellings.

1249 Aung, D.U. 1951. **Selection of silvicultural techniques**. Proceedings of United Nations Scientific Conference on the Conservation and Utilization of Resources, Lake Success, 1949, 5: 117-120.

Discusses methods of ensuring regeneration in teak forests and the plain reserves and the programme of research in Burma.

1250 Aung, U.M. 1979. **Some aspects of artificial regeneration in Burma with particular reference to teak (*Tectona grandis* Linn.f.) and *Eucalyptus* spp**. Tropical Agriculture Research Series 12: 89-95.

1251 Banoewidjojo, M. 1957. **Note on natural regeneration of teak: Indonesia**. FAO Teak Sub-Commission FAO/TSC-57/28: 4p.

The history of natural regeneration of teak in Indonesia from 1854 (after Millier), 1896 (Kunst) and 1905 (Tobi) is described. The method of natural regeneration followed is described and the problem is indicated.

1252 Barrett, H.B. 1939. **Note on Mohnyin Reserve, Mitkyina Division**. Indian Forester 65: 550-558.

Mohnyin Reserve is rich in teak, but natural regeneration is poor. Briefly given the history of Mohnyin reserve, its constitution, exploitation and revenue of the reserve.

1253 Barrett, H.B. 1947. **The natural and artificial regeneration of teak in Burma**. Irish Forestry: 4-10.

1254 Becking, J.H. 1928. **The culture of teak on Java - a comparison of different methods of teak regeneration in Java**. Dissertation, Wageningen, The Netherlands.

1255 Becking, J.H. 1929. **Methods of teak regeneration in Java**. (Indonesian). Forestry Rundschau 2: 82p.

1256 Beekman, H. 1919. **The forest regeneration question**. (Indonesian). Tectona 5: p1.

1257 Blanford, H.R. 1917. **Teak regeneration under the uniform system in Mohnyin, Burma**. Indian Forester 43(8): 339-362.

Advantage of combining regeneration with taungya cutting is pointed out. The experimental taungya method is described and suggests to complete extraction of timber before regeneration. The author advocates artificial regeneration to replace natural regeneration methods. The problem of introduction of mixtures is discussed.

1258 Blanford, H.R. 1925. **Regeneration with assistance of taungya in Burma**. Indian Forest Records (Silviculture Series) 2(3).

1259 Blanford, H.R. 1946. **Natural and artificial regeneration of teak in Burma**. Empire Forestry Review 25(1) [Indian Forester 73, 1947: 127-129].

A review paper gives the following conclusions on natural regeneration - (1) In moist tropical forest it is inferior in results to taungya (2) established regeneration already existing can be tended at reasonable cost like girdling, and improvement fellings in bamboo flowered areas, (3) In drier teak forests natural regeneration can be established by the use of taungya. Gap planting in bamboo flowered areas and the methods and possibility to supplement natural regeneration are also discussed.

1260 Boonkird, S; Unahanand, P. 1959. **Report of the result of experiment on teak regeneration**. (Siamese). Vanasarn 17(1): 9-14.

Results of the statistical experiments in replicated plots laid out in natural teak forest are presented. Experiments are as follows: (1) undergrowth removed, (2) undergrowth burnt, (3) undergrowth removed and soil broken to 20 cm. depth, (4) combination of cutting and burning undergrowth with soil cultivation, (5) control. Assessment of results after a year showed no significant difference in number or size of teak regeneration as between treatments or the control.

1261 Brooks, R.L. 1938. **Notes on the growing of teak (*Tectona grandis* Linn.f.) in Trinidad**. Trinidad Forest Department Leaflet 7: 14p.

Contains an account of teak in its natural habitat in Trinidad, with notes on silvicultural characters and requirements, formation and tending of stands and utilization. Statistics are given for the Trinidad plantations. Yield tables are given for comparison with those of the Indian plantations at Nilambur.

1262 Bruce, C. 1906. **The reproduction of teak**. Indian Forester 32(8): p390.

Illustrating the continuous and yearly felling of bamboos under Burma improvement fellings, describes the beneficial way teak has sprung up over the last 15 years. The effect is more pronounced in outside fire-protected areas. Fire protection is harmful to teak due to profuse growth of bamboo.

1263 Bruinsma, A.E.J. 1927. **Notes on the regeneration of teak forests-1903**. (Indonesian; English). Tectona 20: 283-308.

1264 Buit, S.S. 1959. **A note on the occurrence and regeneration problems of teak, in Vidharbha**. Proceedings of All India Teak Study Tour and Symposium, 1957 December - 1958 January, Forest Research Institute, Dehra Dun, 1959: 154-156.

Describes teak forests of Vidharbha. Plantations using stumps or transplants using local Dona technique are successful, but artificial regeneration over large areas is considered costly. The difficulty in obtaining natural regeneration locally is discussed. It was concluded that the micro-edaphic factors, soil moisture, intensity of light etc. explain the variation in regeneration conditions.

1265 Carrapiett, J.B. 1955. **Regeneration of teak in Burma**. Burmese Forester 5(1): 48-57.

Describes the methods of regeneration used in the old plantations in gaps in the forests, regular plantations made since 1918 and natural regeneration obtained by girdling and climber cutting.

1266 Cater, J.C. 1941. **The formation of teak plantations in Trinidad with the assistance of peasant contractors**. Caribbean Forester 2: 147-153.

The cleared forest land selected for planting teak is allotted to peasant contractors for 15 months in return for keeping the area free from weeds and complying with other specified requirements. They plant and harvest one crop before and another crop after the planting of stump plants of teak by the Forestry Department.

1267 Champion, S.H; Brasnett, N.V. 1958. **Choice of tree species**. FAO Forestry Development Paper 13, 1958: 307p.

This section of the World Forest Planting Manual deals with the principles and factors that guide the choice of tree species for planting on various sites. Part 3 of the publication includes information about selected species including *Tectona grandis*.

1268 Chaubey, O.P; Tiwari, K.P. 2000. **Natural regeneration in managed forests**. Vaniki Sandesh 24(4): 14-27.

This paper discusses the different factors affecting regeneration of forest ecosystems in Madhya Pradesh such as restoration, rehabilitation, reclamation and assisted natural regeneration. The results of case studies on the regeneration of sal and teak are described.

1269 Chaudhuri, A.B; Sowani, M.Y; Mahajan, N.M; Agarwala, V.P; Datta, R.C; Ullah, M.H; Ticku, B.L; Singh, J; Qureshi, I.M; Saxena, V.S. 1977. **Recent trends in techniques of artificial regeneration**. Proceedings of the 11th Silvicultural Conference, Dehra Dun, 15-25 May 1967: 483-540. Forest Research Institute, Dehra Dun.

Dealt with different species which include teak and *Eucalyptus* in Mysore.

1270 Chitwadgi, S.S. 1954. **Artificial regeneration with selection methods of working compensatory diffuse plantations**. Indian Forester 80(3): 160-164.

Discusses with the teak forests of N. Kanara, Bombay, the advantages of supplementing advance growth by patch planting in gaps instead of clear felling and planting, and the resultant problems of management.

1271 Chitwadgi, S.S. 1956. **Teak regeneration in the forests of Bhopal state (Madhya Pradesh)**. Proceedings of the 9th Silvicultural Conference, Dehra Dun, 1956 Part I: p84.

It is suggested that the present system of coppice with reserves should be abolished and simple coppice supplemented with artificial planting be adopted. Planting should be in patches and the total area planted should be 10-25 percent of the annual coupe.

1272 Chollet, A. 1956. **Teak in Togoland**. (French). Bois et Forests des Tropiques 49: 9-18.

The introduction of teak dates from 1905; it now covers 4500 ha. and its power of vigorous natural regeneration has resulted in the formation of gallery forest from roadside plantings. Afforestation of savanna, by taungya or by direct planting after grass cutting, is now being undertaken on a large scale. Methods are described.

1273 Chuntanaparb, L. 1969. **Effects of improvement felling on increment and natural regeneration of teak forests**. (Thai; English). Forest Research Bulletin 7: 25p. Kasetsart University, Bangkok.

Data on teak increment in terms of girth, basal area merchantable volume as well as natural regeneration of teak were recorded annually in Mae Huad Forest, Amphur, Ngao Lampang. Increase in natural regeneration of teak was found to be effected by improvement felling.

1274 Conolly, J.D. 1928. **Teak regeneration**. Indian Forester 54(6): 377-378.

The author emphasizes the effect of soil aeration on second rotation teak crops in Nilambur, after describing the method of regeneration adopted, and considers that height growth almost doubles in first two years with soil aeration and ploughing.

1275 Dasappa. 1989. **Geographical distribution and problems of regeneration in teak (*Tectona grandis* Linn. f.)**. Myforest 25(4): 337-355.

A review with reference to the ecology and silviculture of teak in the tropics.

1276 Davis, L.C. 1904. **Reproduction of teak in bamboo forest in Lower Burma**. Indian Forester 30(8): 378-381.

Author is of the opinion that we can improve the condition of the forests by removing mature teak trees and the consequence will be serious if all teak seed bearers are removed. It will affect the natural regeneration of teak.

1277 Dawkins, C.G.E. 1921. **Early burning in young regeneration areas**. Burma Forest Bulletin 2: 1-6.

1278 Dhanmanonda, P; Sahunalu, P. 1992. **Research on natural forests**. Proceedings of the Seminar on 50 Anniversary of Hyay-Tak Teak plantation, Bangkok, 5-8 August 1992.

Past and present studies on the mixed deciduous forest with teak at Mae Huad, Lampang province are compiled. The establishment period of teak ranged from 4-30 years. Teak harvested in Northern Thailand in 1985 was only one-tenth of that harvested in 1971. The dramatic decrease has been attributed by some authors to loss of trees through shifting cultivation and intensification of modern agriculture. This report examined the possibility that previous removal of large trees during selective logging is also a reason for present low yield of teak. After selection cutting, most of the remaining teak was concentrated in diameter size classes less than 50 cm.

1279 Dhareshwar, S.S. 1939. **Honavar Range and teak regeneration**. Indian Forester 65: 406-424.

The forests of the Honavar Range in the Western Forest Division, Kanora, cover an area of approximately 184 square miles. A portion of the reserve forest has been organized under four different working plans, the most important of which is the Working Plan for the Below Ghat Inland Forests which is concerned with the management of nearly 38 square miles of the moist deciduous forest. This plan was introduced in 1928 and its object is to. convert the forest into a timber-producing, teak-bearing, deciduous mixture with at least 50 percent teak. The prescribed treatment is clear felling with artificial regeneration of teak.

1280 Dubey, R.K. 1967. **Natural and artificial regeneration in teak forest in Madhya Pradesh**. Proceedings of 11th Silvicultural Conference, Dehra Dun, 1967 Part I Item 2.

The paper makes a classification of teak zone of Madhya Pradesh into smaller types according to climate, and status of natural regeneration with prospects of teak reproduction in each type both by natural and artificial means.

1281 Egenti, L.C. 1979. **On seeding habits of *Tectona grandis* Linn.f.** Proceedings of a symposium on flowering and seed development in trees, Mississippi State University, 15-18 May 1978: p360. Southern Forest Experiment Station, Starkville, Mississippi.

The state of knowledge of the ecology of teak and the relationship of the species with the environmental factors.

1282 Essenburg, J.F.W. 1937. **Additional natural regeneration (teak) after 35 years in the first and fifth annual plots in Motatal in the Randoeblatoeng forest section**. Tectona 30: p716.

1283 FAO. 1993. **Teak: A plundered world heritage. A memorial issue**. RAPA Occasional Paper 8: 15p. FAO.

1284 Forest Department, Burma. 1949. **Natural regeneration of teak**. Report of Working Plans, Silviculture Entomology, Forest Department, Burma 1945-46: 39p.

The efforts to induce natural regeneration in Shan states was described and the problems of invasion by dense growth of *Eupatorium odoratum* on clearings made under seed bearers was discussed. Damage to established regeneration by elephants was also indicated.

1285 Forest Research in India and Burma. 1941. **On slash burning and teak regeneration**. Forest Research in India and Burma 1939/40, Part I: p133.

The effect of slash burning on artificial reproduction was found to vary with different species and has a stimulating effect on the stump plants of teak. Beneficial effects were generally slightly greater for areas where slash was burnt and the ashes worked into top soil of unburned plots. Analysis of soil samples taken from the treated plots indicated that burning and application of slash have a marked effect in increasing the pH, while soils on which the slash was burned and the ash removed showed relatively low value for nitrates.

1286 Forest Research in India and Burma. 1941. **On teak natural regeneration in Burma and Madras: Stump planting of teak**. Annual Report of Forest Administration, Silviculture Research in Burma and Madras 1938/39. Forest Research in India and Burma.

Frill girdling and sodium arsenitic poisoning of the larger trees round teak seed bearers as an aid to natural regeneration is found to be less costly than felling but the degree of success is yet uncertain in Burma. In Madras details of teak nursery techniques along with costs are given.

1287 Forest Research Institute, Dehra Dun. 1947. **The natural and artificial regeneration of teak**. Proceedings of the 6th Silviculture Conference, Dehra Dun, 1945: 71-84.

Nine papers describing current methods and opinions on Teak regeneration in different provinces.

1288 Forest Research Institute, Dehra Dun. 1956. **Natural regeneration of teak**. Proceedings of the 9th Silvicultural Conference, Dehra Dun, 1956.

The problem with reference to different mixed deciduous both dry and moist types was discussed and recommendations were made for augmenting natural regeneration of teak and undertaking a joint cooperative work of teak forest areas was recommended to determine the most feasible technique of natural regeneration of teak.

1289 Forest Research Institute, Dehra Dun. 1956. **Artificial regeneration of teak**. Proceedings of the 9th Silvicultural Conference, Dehra Dun, 1956: p90.

Reviewing extensive research undertaken during the last three decades on the artificial regeneration of teak.

1290 Forest Research Institute, Dehra Dun. 1961. **Recent trends in techniques of artificial regeneration**. Proceedings of the 10th Silvicultural Conference, Dehra Dun 1961, Vol. 1: 335-438.

Includes two papers on *Tectona grandis*.

1291 Forest Research Institute, Dehra Dun. 1961. **Recent trends in techniques of natural regeneration (teak)**. Proceedings of the 10th Silvicultural Conference, Dehra Dun, 1961, Vol. 1: 287-292.

It was recommended to implement the recommendations of All India Teak Symposium of 1957-58, particularly specific procedures for obtaining natural regeneration in very moist types and to undertake cooperative research projects for obtaining natural regeneration with teak as predominant constituent.

1292 Forest Research Institute, Dehra Dun. 1967. **Recent trends in techniques of natural regeneration of teak**. Proceedings of the 11th Silvicultural Conference, Dehra Dun: p605.

(a) Considerable areas of dry, semi-moist and moist teak forests in Madhya Pradesh, Maharashtra, Gujarat, etc., are managed under systems of natural regeneration (b) comprehensive study of the factors governing the recruitment and establishment of teak regeneration has not been done in detail; (c) the technique for inducing natural regeneration has not been perfected so far, particularly in areas infested with weeds.

1293 Forest Research Institute, Dehra Dun. 1967. **Recent trends in techniques of artificial regeneration of teak**. Proceedings of the 11th Silvicultural Conference, Dehra Dun: p607.

Extensive teak plantations are being raised in many states, seed collection, pretreatment and grading planting stock need improvement, proper evaluation of the plantation sites in non-teak areas as to their suitability is of vital importance, the role of chemical fertilizers, weedicides and their economics has not been studied in detail.

1294 Forest Research Institute, Dehra Dun. 1977. **Recent trends in techniques of natural regeneration**. Proceedings of the 11th Silvicultural Conference, Dehra Dun, 15-25 May 1967: 408-482. Forest Research Institute, Dehra Dun.

Reports are given on problems and progress with various species and in various regions which include a report of teak in Madhya Pradesh.

1295 Foulkes, F. 1914. **Teak in the Wynaad: A study Part III M. (C). Reproduction of teak from seed**. Indian Forester 40(7): 315-330.

Information is furnished from Wyanad and advocates detailed study of teak in its natural habitat in different sites.

1296 Gamble, J.S. 1921. **Artificial regeneration of teak by sowing**. Indian Forester 47(1): 43-44.

The author describes the pretreatment method of teak seeds as practiced in Bomanpokri T.P. Darjeeling Division in 1874, which consisted of mixing the seed with soil and watering in an exposed sunny area and germinating seeds transferred to beds.

1297 Gogate, M.G; Ghude, D.B; Deshpande, M.D. 1997. **Experimental entire transplant technique for teak**. Indian Forester 123(9): 793-800.

Teak is normally artificially regenerated using the stump planting technique. The loss of almost one year's shoot growth necessitated by this method could be avoided by using the Entire Transplant Technique (ETP). This paper reports pilot scale work on the use of ETP for teak at the Wada Research Nursery.

1298 Griffith, A.L. 1942. **The effects of burning on the soil as a preliminary to artificial regeneration**. Indian Forest Bulletin 13.

1299 Griffith, A.L. 1945. **The natural and artificial regeneration of teak**. Proceedings of 6th Silvicultural Conference, Dehra Dun: 2-4. Forest Research Institute India, Dehra Dun.

The effect of war on silviculture and artificial regeneration of teak was discussed. Varying degrees of success has been achieved with natural and artificial regeneration. The author has reported the over exploitation of teak and recommends measures to normal management.

1300 Gupta, A.C. 1945. **The natural and artificial regeneration of teak**. Proceedings of 6th Silvicultural Conference, Dehra Dun.

Reports the problems of teak natural and artificial regeneration from Bengal from experimental plots in Kurseong Division. A comparative study of both methods of regeneration is made.

1301 Hamilton, A.P.E. 1954. **Methods of increasing growth and obtaining natural regeneration**. 4th World Forestry Congress, Session 5: Tropical Forestry FAO/54/9/4999: 1-34.

Teak types are described both natural and plantation origin in Africa and West Indies. Discussion is mainly confined to India and Burma. Teak distribution, silviculture and management practices are outlined and problems are suggested for future research.

1302 Hart, H.M.J; Noltee, A.C. 1927. **Regeneration and tending of teak**. (Dutch; English). Tectona 20: 199-213.

Oldest teak plantations date to beginning of 19th century. In 1865 natural regeneration is officially prescribed, and in 1873 agriculture silvicultural methods introduced. Interculture with *Leucaena, Indogofera galegoides* and *Imperata cylindrica* started around 1900. Inmixing will be carried more intensively and schedule of future thinning are suggested for teak plantations and choice of thinning methods discussed in detail.

1303 Hla, U.T. 1979. **Some observations of natural regeneration of teak (*Tectona grandis* Linn.f.) in teak bearing forests of Burma**. Tropical Agriculture Research Series 12: 97-105.

1304 Hodge, W.E. 1945. **The natural and artificial regeneration of teak**. Proceedings of 6th Silvicultural Conference, Dehra Dun 6.

Reporting from North Bengal and Chittagong Hills where teak has been sown for many years, the author opines poor quality teak fetches better price than first quality sale and reports on experiments in progress to find out suitable associates.

1305 Hussain, T. 1960. **Progress report on teak forestry in Pakistan 1957/1959**. FAO Teak Sub-Commission, New Delhi, 1960 FAO/TSC-60/2.8: 6p.

Mainly two aspects are covered ie., silviculture and management and utilization.

1306 Kadambi, K. 1956. **Natural regeneration of teak**. Proceedings of the 4th World Forestry Congress, Dehra Dun, 1954, 3: 293-298.

The author discusses the various factors which influence the natural regeneration of teak and its establishment and points out instances of natural reproduction of teak in India.

1307 Kadambi, K. 1957. **Natural reproduction of teak. The silviculture of gregarious types**. Tropical Silviculture 2: 187-192.

The factors influencing natural regeneration of teak are listed and the inherent capacity of teak seed is at first very sensitive to drought. Success of natural reproduction depends on water retentivity of soil during the summer months. The hard seed coat prevents premature germination and soft soil is required when seedling develops a strong tap root. The requirements of teak natural regeneration and establishment with reference to soil, light and other factors like weeds and grazing and fire are described and discussed.

1308 Kadambi, K. 1959. **Observations on natural reproduction of teak**. Indian Forester 85(11): 641-649.

A review of all the factors bearing on the problem in India.

1309 Kaikini, N.S. 1956. **Natural regeneration of teak**. Proceedings of the 9th Silvicultural Conference, Dehra Dun, 1956. Part 1: 58-65.

Described in some detail, by forest types.

1310 Kaikini, N.S. 1960. **Natural regeneration of teak in Bombay state**. Proceedings of the 9th Silvicultural Conference, Dehra Dun, 1956 Part I, 1960: 58-65.

Describes in some detail by forest types the natural regeneration of teak.

1311 Kartna, S. 1963. **Natural regeneration of teak**. FAO, Rome.

Observations are made on teak flowering and fruiting in Lampang, Thailand, and germination of teak seed and early growth of teak seedlings.

1312 Kermode, C.W.D. 1939. **The efficiency of irregular stocking Part II, Item 8**. Proceedings of the 5th Silvicultural Conference, Dehra Dun. Forest Research Institute, Dehra Dun.

In view of vastness of teak forest areas, conversion into even-aged areas is impracticable. The author recommends dealing such areas by girdling, mature trees followed by improvement fellings, to assist existing natural regeneration and tending groups of advance growth.

1313 Kermode, C.W.D. 1944. **Natural regeneration without seed bearers**. Indian Forester 70: 289-296.

The author discusses a technique for natural regeneration which has been employed in Burma. A great deal of unnoticed natural generation of teak and other species is present in these burned-over areas and will develop when the canopy is opened up.

1314 Kermode, C.W.D. 1945. **The natural and artificial regeneration of teak**. Proceedings of 6th Silvicultural Conference, Dehra Dun. Forest Research Institute, Dehra Dun.

It is reported that the natural regeneration in moist tropical forests is costly and less successful than taungya culture, at reasonable cost this can be established easily by assisting operations like girdling and improvement fellings and in dry teak forests regeneration of teak by taungya is cheaper and convenient than natural regeneration methods. The paper describes various methods of artificial raising teak in Burma.

1315 Kermode, C.W.D. 1946. **Natural and artificial regeneration of teak in Burma**. Indian Forester 72(1): 15-21.

In the drier teak-bearing forests, natural regeneration of teak can be established by the use of taungya. All teak plantations in Burma have for many years been made by taungya. A considerable amount of experimental work has been done on stump-planting. Other methods of introducing teak artificially have been tried like gap planting.

1316 Kermode, C.W.D. 1952. **The flowering of Kyathaungwa (*Bambusa polymorpha*)**. Burmese Forester 2(1): 9-14.

Notes on regeneration of teak after gregarious flowering of *B. polymorpha*.

1317 Kermode, C.W.D. 1954. **Have methods used for regenerating teak in Burma been failures?** Burmese Forester 4(2): 76-86.

Criticizing an article on teak regeneration by U Saw Tun Aung and maintains that artificial regeneration by taungya plantations and natural regeneration by the seedling coppice method are both good in suitable sites.

1318 Kermode, C.W.D. 1954. **Methods of increasing growth and obtaining natural regeneration of natural teak stands in Burma**. 4th World Forestry Congress, Dehra Dun Part I: 47-55.

The distribution of teak with floristics in six forest types is described. The ecological importance of fire has been discussed as well as a silvicultural toll in regeneration operations. The dormancy of teak seed for one or two years is examined critically and it is reported that research is needed to gain further information on germination and seed dormancy of teak seed and nature of natural regeneration and advance growth.

1319 Kermode, C.W.D. 1954. **Seedling coppice and the seedling coppice system of regeneration**. Empire Forestry Review 33(4): 366-374.

Many species of the mixed deciduous forest of Burma can survive the forest fire. Enumerations show that there is normally an advance growth of seedling coppice of much higher density especially teak. This advance growth can be helped by cutting and burning the overstorey and subsequent tending. Taungya cultivation is also found helping in the advance growth.

1320 Kermode, C.W.D. 1955. **Regeneration with the aid of taungya**. Burmese Forester 5(1): 86-99.

Describes the method of raising teak plantations by taungya method. The work in the first, second, third and subsequent years has been separately described.

1321 Kesarcodi, S.N. 1945. **The natural and artificial regeneration of teak**. Proceedings of 6th silvicultural Conference, Dehra Dun, Item 5. Forest Research Institute, Dehra-Dun.

The results of rab method of artificial regeneration of Bombay pole forests is discussed and compared this with natural regeneration methods both from coppice and seed. Artificial regeneration is found successful in the high forest areas.

1322 Kittinanda, S.P. 1963. **Natural regeneration of teak at Lampang**. (Siamese). Vanasarn 21(4): 261-268.

Only dominant and codominant trees produce seed in natural teak forest. The total seed production of the area was investigated in 1962. Despite heavy seed production, only a few seeds is found germinating. Growth of these seedlings also investigated.

1323 Kramer, F. 1930. **The teak regeneration in the Goendith forest district**. (Dutch; English). Tectona 23(4): 228-293.

Two methods were tried: dibbling seed in poor soils where teak is partially girdled and dibbling coupled with coppice regeneration on medium soils. First method yielded poor results and second method is far from satisfactory. Further research has to be based on natural succession and undergrowth studies of teak forest and offer plenty of sunlight to young teak plants and germinating seeds by planting in rows and soil tending and improvement.

1324 Krishnaswamy, V.S. 1951. **Notes on teak regeneration methods**. Proceedings of 8th Silvicultural Conference, Dehra Dun, 1951, Part 2: 238-239.

The present position in the regeneration technique of teak in the different states has been described. Both natural and artificial regeneration methods including Dona planting of Madhya Pradesh are described.

1325 Kulkarni, D.H. 1963. **Role of advance growth in silvicultural systems, with special reference to semi-moist deciduous forests containing teak (*Tectona grandis*) in Central India and the peninsular sal (*Shorea robusta*)**. Indian Forester 89(10): 663-669.

A general account stressing the need to encourage and preserve advance growth wherever it occur.

1326 Kutintara, U. 1970. **Regeneration of teak in Thailand**. Thesis, Colorado State University, Colorado, 1970: 127p.

The paper describes the methods of increasing teak regeneration and thus producing a higher stock of teak in teak bearing forests of the country. A teak regeneration improvement programme based on silvicultural characteristics of teak, ecology of the forest and the national forest policy is proposed.

1327 Lamba, G.S. 1945. **Teak regeneration in the Central Provinces**. Indian Forester 71: 346-347.

Teak forests in this province is distinguished into two types ie., dry type and moist type. Several problems requiring solutions and natural regeneration are discussed.

1328 Lamba, G.S. 1945. **The natural and artificial regeneration of teak**. Proceedings of 6th Silvicultural Conference, Dehra Dun. Forest Research Institute, Dehra Dun.

The problem of natural regeneration of teak in Central Provinces under selection-cum-improvement and uniform system was discussed along with results obtained since 1926. The natural regeneration is considered cheaper and advantageous, wherever feasible, and recommends gathering accurate scientific knowledge on the problem. The problem of artificial regeneration is generally discussed.

1329 Laurie, M.V; Parker, R.N; Muthanna, M.A; Venkata Rao, K.R; Murthi, S; Raynor, E.W. 1941. **Artificial regeneration in dry forest types. Papers (I) Artificial regeneration in dry forests in Madras. (II) Artificial regeneration in dry forests in the Punjab. (III) Short note on artificial regeneration in dry forests in the Kadur Forest Division, Sakrepatna Tract. (V) A short note on the methods of regeneration employed in afforesting some of the in dry bare hills in the Chitaldrug District. (VI) Artificial regeneration in dry forests types**. Proceedings of the 5th Silvicultural Conference, Dehra Dun, 1939: 419-436.

Details of operations, species used and costs are given in the papers.

1330 Leete, F.A. 1912. **Pyinmana Forest Division: Teak and bamboos in Burma**. Indian Forester 38(8): 355-380.

Discusses the natural regeneration problems in teak forests of Burma and advocates revision of policy on fire protection and diverting funds for works of improvement. The costs of raising plantations and broadcast sowings vs. line sowings are discussed. He pleads for natural regeneration and silvicultural operations and methods of exploitation to be correlated with age and bamboo flowering.

1331 Lindsay, W.R. 1948. **Growing teak in the Canal zone**. Foreign Agriculture 12(9): 197-198.

A brief report on experiments in cultivating teak in the Panama Canal Zone.Sandy or clay loam soil of good depth and drainage is required as it produces a large and deep root system. For rapid germination, seeds need to be soaked in water for 24 hours.

1332 Long, A. 1955. **Burma teak**. Burmese Forester 5(1): 11-27.

A short account of Burma teak, giving its range and rate of growth and making suggestions for increasing the growth. Methods of encouraging natural regeneration are described and plantation policy discussed.

1333 Maheut, J; Dommergues, Y. 1960. **The teak plantations of Casamance: Yield and biological characteristics of the stands, and maintenance of soil fertility**. (French). Bois et Forests des Tropiques 70: 25-42.

A brief historical account of the plantations is given. Results of the enumeration surveys made in several plantations are presented. Deals with teak litter and the influence of teak stands on soil fertility. Its litter decomposes rapidly and inhibits N-mineralization. Application of mineral fertilizers and the introduction of less exacting species either in a mixture or as an understorey are the measures suggested for the prevention of soil deterioration.

1334 Manning, D.E.B. 1941. **Erosion in the Yomas of the North Pegu Forest Division**. Indian Forester 67: 462-465.

In Burma, forest conditions do not prevent erosion in the drier types of forest that are subject to annual grass fires. Fire destroy the protective vegetation, litter and surface humus, besides pulverizing the surface soil and thus rendering it more erodible. Severe silting occurs in most of the streams. Kyathaung bamboo and earthquakes in 1930 were two reasons for severe soil erosion.

1335 Marjoribanks, G.E. 1927. **How the teak pole forests of Thana are regenerated?** Indian Forester 53(3): 125-131.

The system of management and method of regeneration of mixed teak pole forests of Thana Division, Bombay, are described and costs of planting teak upto 5th year are given, and net financial results from two sample coupes are calculated.

1336 Maung Gale, U. 1959. **Regeneration of teak in Burma**. Proceedings of All India Teak Study Tour and Symposium December 1957-January 1958: 185-187.

The paper describes the behaviour of teak in early stages of development, methods of regeneration comprising both natural and artificial.

1337 Maung Gale, U. 1961. **Regeneration of teak in Burma**. Burmese Forester 11(1): 55-57.

Describes the extent of teak forests in Burma, behaviour of teak in the early stages of development, methods of regenerating teak by natural and artificial methods and role of Kyathaung flowering in regeneration of teak.

1338 Millett, G.V. 1907. **Regeneration of teak forest in Java**. Indian Forester 33(5): 243-252.

Describes the present condition and past treatments of teak forests of Java with detailed notes on natural and artificial regeneration methods.

1339 Morel, J. 1967. **Notes on the territory of Papua and New Guinea**. (French). Bois et Forests des Tropiques 115: 15-31.

A description is given of the forests, the system of exploitation, the organization of the forest service and silviculture. Silvicultural trials are based on natural regeneration and artificial regeneration for species including teak. Problems of improvement of teak and reforestation of savannas are discussed.

1340 Mujumdar, R.B. 1956. **Natural regeneration of teak in Madhya Pradesh**. Proceedings of the 9th Silvicultural Conference, Dehra Dun, 1956. Part 1: 65-68.

Vast areas with adequate reproduction have been successfully regenerated under conversion fellings. Continued fire protection in the moister types results in development of evergreen forest which prevents natural regeneration of teak.

1341 Nair, P.N. 1981. **Natural regeneration of teak in old teak plantations in moist deciduous areas**. Indian Forester 107(3): 155-157.

In a survey in 1977, regeneration was observed after felling of a stand planted in 1905 and surrounded by younger plantations in Konni Division, Kerala. Abundant seedlings were present in areas not affected by wildfires or grazing which was not usual for teak in the moist deciduous zone.

1342 Nicholson, J.W. 1945. **Teak regeneration in Orissa**. Indian Forester 71: 365-367; Sixth Silvicultural Conference, Dehra Dun, 1945.

Teak occurs naturally in some parts of Orissa but is of poor quality owing to dryness of climate and poor soil. About 60 years ago a few teak plantations were formed in dry-type forests in the divisions of Angul and Puri. As natural regeneration has been profuse in the oldest teak plantations, it has been decided that it will be more profitable interplanting teak with other species like bamboo.

1343 Oever, H.Ten. 1909. **Teak seedlings in the natural forest**. Tectona 2: 372-373.

1344 Oever, H.Ten. 1912. **Natural regeneration of teak (*Tectona grandis*)**. Tectona 6: 68-71.

1345 Oever, H.Ten. 1921. **Teak and Hindoos**. Tectona 14: 652-658.

1346 Pande, P.K; Bisht, A.P.S. 1988. **Regeneration behaviour of some tree species of some forested ecosystems**. Journal of Tropical Forestry 4(1): 78-84.

The population structure and regeneration status of tree species in plantations of *Shorea robusta*, *Tectona grandis*, *Eucalyptus* and *Pinus roxburghii* was studied in the demonstration area of New Forest, Dehra Dun. The study was carried out using the quadrat method with 10 running quadrats for teak. The absence of seedlings and saplings of pine, teak and eucalypts showed lack of their regeneration in the area.

1347 Porter, H.J. 1894. **Failure of natural reproduction in the teak forests of the Coimbatore district**. Indian Forester 20(8): 285-287.

Discussing causes of failure of natural reproduction in spite of complete fire protection in Anamalais and recommends working up of the soil under seed trees and ploughing in the seed, dense undergrowth prevents seedling establishment and growth, fire protection even though good for mature trees is no good for teak regeneration and exclusion of cattle is harmful in moist tract in encouraging grub attack. Loosening of soil and removal of undergrowth is recommended.

1348 Prasad, R.C. 1956. **Artificial regeneration of teak**. Proceedings of the 9th Silvicultural Conference, Dehra Dun, 1956. Part 1: p83 .

A brief account of the sporadic work undertaken in the past and of the systematic and more extensive work now planned is given with a note on the Palamau nursery germination technique.

1349 Prasad, R; Mishra, G.P. 1981. **Establishment of natural regeneration with special reference to dying back in dry deciduous teak forests of Sagar (M.P.)**. Indian Journal of Forestry 4(3): 165-172.

Observations were made of the dynamics of root and shoot growth of species including teak each growing on three soil types as part of a study of the effects of dying back on regeneration period. The relation of root/shoot ratio at various ages to dying back is analysed. Some drought mechanisms developed in annual and perennial herbs and climbers are briefly described.

1350 Quint, M.P.L. 1956. **Report on teak in Dahomey**. (French). Proceedings of the 4th World Forestry Congress, Dehra Dun, 1954: 339-342.

1351 Qureshi, I.M. 1951. **Regeneration of flowered bamboo area**. Proceedings of 8th Silvicultural Conference, Dehra Dun, 1951, Part 2: 294-295. Forest Research Institute, Dehra Dun.

Establishment of teak after gregarious flowering of *Dendrocalamus strictus* and *Bambusa arundinacea* in the mixed moist deciduous forests of Kanara, Belgaum and Dangs divisions of Bombay state is discussed.

1352 Qureshi, I.M. 1956. **Natural regeneration of teak in moist deciduous forests of Deccan Plateaux (Bombay state)**. Proceedings of the 9th Silvicultural Conference, Dehra Dun, 1956, Part 1: 68-69.

A general account of unprecedented natural regeneration in the division is investigated.

1353 Rai, L; Datta, R.N. 1952. **Regeneration of the mixed teak forests in Madhya Pradesh**. FAO Asia Pacific Forest Commission FAO/APFC/52/17: 4p. FAO, Rome.

The mixed deciduous teak forests of Madhya Pradesh are described and the problems of regeneration in dry, intermediate and moist type of forests are discussed and suggestions are made on artificial planting of teak.

1354 Regd, J.D. 1917. **Regeneration of teak in the Mungod Pole forest of North Kanara**. Indian Forester 43(4): p197.

Describes regeneration work where teak seedlings are weeded.

1355 Roosendael, J van. 1928. **Natural regeneration of teak**. (Dutch; German). Tectona 21: 257-266; Forest Rundschau 1: p115.

1356 Sagreiya, K.P. 1947. **Natural regeneration of moist teak/bamboo forest**. Report of Forest Department, Central Provinces and Berar 1945-46: 14-15.

The difficulty of obtaining a well stocked two-storeyed forest with teak in the upper storey and bamboo in the lower, is largely due to the different rates of growth of the two species. The system practised in the Central Provinces is described.

1357 Sagreiya, K.P. 1956. **Methods of increasing growth and obtaining regeneration in the deciduous forests of Central India**. Proceedings of the 4th World Forestry Congress, Dehra Dun, 1954, 3: 363-388. (Tropical Silviculture 2, 1957); (FAO Forestry and Forests Products Studies 13: 257-282).

Describes the principal forest types of western Madhya Pradesh, silvicultural methods with special reference to teak, protection and research needs.

1358 Sagreiya, K.P. 1961. **Recent trends in techniques of natural regeneration (teak)**. Proceedings of 9th Silvicultural Conference, Dehra Dun, 1961: 287-292.

Summary of discussions on the subject are given.

1359 Schokker, P. 1910. **Regeneration of teak in the Grobogan forest section**. Tectona 2: 225-266.

1360 Seth, S.K; Khan, M.A.W. 1958. **Regeneration of teak forests**. Indian Forester 84(8): 455-466.

Forests of the teak zone of India are described. Champion's types of teak forest are discussed and proposals made for a revised classification of types, to meet the requirements of intensive management practices followed at present. Factors controlling the occurrence and development of regeneration are detailed and proposals are made for future research to solve the problems of natural and artificial regeneration of teak zone of India.

1361 Seth, S.K; Khan, M.A.W. 1959. **Regeneration of teak forests**. Proceedings of All India Teak Study Tour and Symposium, Dehra Dun: 107-120.

Forests of the teak zone of India are described. Champion's types of teak forest are discussed and proposals are made for a revised classification of types to meet the requirements of intensive management practices at present followed. Factors controlling the occurrence and development of regeneration are detailed and proposals are made for future research to solve the problems of natural and artificial regeneration in the teak zone of India.

1362 Singh, J; Mahajan, A.G. 1998. **Natural regeneration status in Melghat forests - an overview**. Indian Forester 124(4): 186-196.

The Melghat forests of Maharashtra are dominated by teak. The forests are managed by the selection system. The concept of natural regeneration adequacy is discussed and 440 seedlings/ha suggested as suitable. Various ecological factors like nutrient depletion by grass cover and shade from

shrubs and bamboos in the understorey and fire reduced establishment. Ways to overcome these problems are briefly discussed.

1363 Sono, P. 1964. **Note on growth of teak seedling in natural forest**. (Siamese). Vanasarn 22(1): 54-66.

It is indicated that 7-29 years were required before seedlings become safe from yearly burnings, a root diameter, u.b., of 18.4 mm. at 25 mm. below ground level seemed critical for mere survival and this represents approximately eight years of growth. The author recommends stump planting.

1364 Spaan, W.J. 1912. **Natural regeneration of teak forests**. Tectona 5: 571-576.

1365 Srivastava, S.S. 1949. **Regeneration of teak both a puzzle and solution**. Madras Forest College Magazine 25(4): 161-166p.

Lists the factors which favour or adversely effect teak regeneration in different types of forest areas.

1366 Stoutjesdijk, J.A.J.H. 1923. **Natural regeneration tests**. Tectona 16: 823-830.

1367 Sumantakul, V; Yingransiri, T. 1979. **Effect of partial on heartwood development of teak (*Tectona grandis* Linn.f.)**. (Thai). Report on Silviculture 1977-78: 85-86. Ministry of Agriculture and Cooperatives, Bangkok. Royal Forest Department, Silviculture Division.

1368 Suttie, W.R. 1960. **Progress report on teak forestry in the Territory of Papua and New Guinea**. FAO Teak Sub-Commission, New Delhi, 1960, FAO/TSC-60/2.7: 5p.

The following aspects are covered. General information, area planted, locality factors, forest types, seed origin, plantation establishment, pests, diseases, protection, rate of growth, rotation and yield.

1369 Swain, S.L; Behera, N. 1998. **Qualitative analysis of vegetation from a regenerating teak forest of Orissa, India**. Journal of Ecobiology 10(1): 13-18.

Vegetational analysis was undertaken of tree species in a regenerating teak forest in Sambalpur, Orissa. On the basis of importance value index, *Tectona grandis* was the dominant species at all the sites except one. The relative contribution of *Tectona grandis* to total IVI varied from 34.8 to 64.5 percent over the sites. Total density ranged from 1670 to 4060 stems/ha and the total basal area from 4.47 to 124.51 m2/ha. There was a trend towards an inverse relationship between diversity and dominance.

1370 Sweet, J.M. 1945. **The natural and artificial regeneration of teak**. Proceedings of the 6th Silvicultural Conference, Dehra Dun. Forest Research Institute, Dehra Dun.

Reports on well-versed Madras experience in artificial regeneration techniques and recommends on collecting from other experience on natural regeneration methods.

1371 Takle, G.G; Majumdar, R.B. 1957. **Increasing growth and natural regeneration of teak**. Tropical Silviculture, FAO Forestry and Forest Products studies 13: 237-256. FAO, Rome.

The paper deals with distribution of teak in Madhya Pradesh with reference to climate, geology, elevation and soil. Teak forests were described with reference to locality factors and Champion's forest types. The suitability of soils for teak forest are discussed and teak is considered as a biotic climax and effect of various biotic factors and silvicultural factors on teak forests are discussed.

1372 Takle, G.G; Mujumdar, R.B. 1956. **Increasing growth and regeneration of teak**. Indian Forester 82(1): 8-21.

Reviews the ecological status of mixed teak forests in Madhya Pradesh, silvicultural methods and the state of natural regeneration.

1373 Tarasingh. 1932. **Notes on regeneration technique in the Central Provinces**. Indian Forester 58(12): 704-712.

The regeneration techniques such as artificial regeneration of teak, the dona planting system and its advantages, firing of the forest to be naturally regenerated with teak and use of Boga and Arhar cover crops for plantations are described.

1374 Thaiutsa, B; Puangchit, L; Yarwudhi, C; Wacharinrat, C; Kobayashi, S. 2001. **Coppicing ability of teak (*Tectona grandis*) after thinning**. Rehabilitation of degraded tropical forest ecosystems. Workshop Proceedings, Bogor, 2-4 November 1999. S. Kobayashi; J.W. Turnbull; T. Toma; T. Mori; N.M.N.A Majid, Eds: 151-155. Center for International Forestry Research, Jakarta.

The research was carried out to determine the effects of different thinning methods on coppicing ability of 17-year-old teak.

Different thinning methods are followed and found that the thinning methods did not affect shoot density, but affected shoot growth. The findings indicate that shoot growth is promoted by wider gaps after thinning due to the light-demanding characteristics of teak.

1375 Thampi, K.B. 1997. **Environmental impacts of teak regeneration and culture**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 262-269. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Kerala plantation forestry has a long history dating to the 1840s when teak planting commenced in the Nilambur valley. Two teak rotations have been completed and planting has been done for the third. The paper discusses the impact of a century and a half of teak plantation on a wide spectrum of the environment including: biodiversity, soil deterioration, soil erosion, climatic changes, wildlife, recreation, stream flow, slash burning, grazing and forest cultural practices.

1376 Thittaw-Wunmin. 1904. **Reproduction of teak in areas of flowered bamboo**. Indian Forester 30(9): 419-421p.

With reference to proposed reorganization of Burma Forest Department, the author discusses and proposes the treatment of Kyathaungwa teak forests, after bamboo flowering, examining administrative problems.

1377 Thorenaar, A. 1941. **On regeneration in combination with agriculture in Bagelen**. (Dutch). Tectona 34: 679-686.

This method of clearing and planting work in the Bagelen district, Java, is owing to the severe erosion that takes place on unprotected sites. The method of planting work followed for the afforestation is discussed in detail. Teak is the most important tree species.

1378 U Saw Tun Aung. 1952. **Regeneration of teak in Burma**. Burmese Forester 2(2): 71-78.

It is presumed that most of the old teak stands in yoma forests originated after gregarious flowering of bamboo. It is suggested that natural regeneration in such stands is inadequate and should be supplemented by stump planting in openings. Wide spacing in partial sunlight will prevent epicormic branching.

1379 U Saw Tun Aung. 1955. **Regeneration of teak in Burma**. Burmese Forester 5(2): 100-107.

A reply to criticisms of the author's views on teak plantations by C. W. D. Kermode.

1380 Venkataramany, P. 1956. **Experiments on coppice regeneration of teak**. Proceedings of the 9th Silvicultural Conference, Dehra Dun, 1956. Part 1: 74-75.

It was found that there was no difference in stool mortality either between high or low stools or between trimmed and untrimmed stools. It was found that by reducing the number of coppice shoots to one per stool, gave best diameter and height growth.

1381 Venkataramany, P. 1956. **Progress of research on the artificial regeneration of teak in the Madras State, 1926 to 1956**. Proceedings of the 9th Silvicultural Conference, Dehra Dun, 1956. Part 1: 75-83.

An account of the experiments undertaken is given with their results and conclusions.

1382 Venkataramany, P. 1960. **Summary of discussions on natural and artificial regeneration of teak**. Proceedings of the 9th Silvicultural Conference, Dehra Dun 1956, Part 2. Forest Research Institute, Dehra Dun.

Gives summaries of the discussions on the subject as presented by various participants.

1383 Walker, H.C. 1904. **Reproduction of teak in bamboo forests in Lower Burma**. Indian Forester 30(2): 51-55; 30: p378.

The works carried out in exploited teak forests by taungya plantations and improvement fellings to aid natural regeneration are described in detail with reference to requirements of teak and locality factors of Burma.

1384 Walker, H.C. 1909. **Reproduction of teak in Burma**. Indian Forester 35(6/7): 367-376.

Reproduction of teak in Burma with reference to bamboo flowering has been discussed with reference to current experiments of natural regeneration.

1385 Westra, J.G. 1921. **Natural regeneration of teak forests**. Tectona 14: 643-651.

1386 White, K.J; Cameron, A.L. 1965. **Silvicultural techniques in Papua New Guinea: Forest plantations**. Division of Silviculture, Department of Forestry, Papua and New Guinea 1: 99p.

A guide to plantation establishment, with instructions on site preparation and chapters on species including *Tectona grandis* with notes on their distribution and ecology, seed collection, nursery techniques, establishment, thinning, pruning, pests, diseases and fire sensitivity.

1387 Wimbush, A. 1920. **Artificial regeneration of teak by sowing**. Indian Forester 46(9): 488-492; 47: p43.

Describes the details of the regeneration method with costs in the Mount Stewart forest of South Coimbatore Division.

1388 Win, U.N. 1951. **A note on Kyathaung (*Bambusa polymorpha*) flowering in Pyinmana**. Burmese Forester 1(2): 52-56.

Opportunity to introduce teak.

Go top

Seeds collection, storage and germination

(See also 0562, 0690)

1389 **Memorandum of teak sowings in flowered bamboo forest**. Indian Forester 13, 1887: 512-516.

The salient features of the system of increasing proportion of teak in two reserves of Tharrawaddy division is given. The method is described in detail and illustrated with examples from Burma experience.

1390 **Stimulating the germination of teak seeds**. Indian Forester 26(6), 1900: p279.

Teak seed placed in a shallow pit 1.5 ft. deep, filled with water and watered every four days found germinated in another five days. In another experiment, seeds soaked in lukewarm water for twenty four hours reported germinated in 12-24 hours in Surat division.

1391 **Teak comparison of seeds from plantation and from natural forests**. Forest Research in India Part II 1954-55, 1955: p74.

There is no significant difference between the two seeds. In Madras state seed is being mostly collected from plantations.

1392 **Teak sorting of seed by size**. Forest Research in India Part II 1954-55, 1955: p74.

There is no significant difference in the mean heights of trees raised from seeds of different sizes.

1393 **Teak: Effect of size, age and condition of seed bearers**. Forest Research in India Part II 1954-55, 1955: p74.

Seed from over mature trees is as good as mature trees and hence seeds can be collected from all trees except immature trees.

1394 **On teak seed germination**. Forest Research in India and Burma 1962-63, Part II, 1963.

In the Subansiri forest division of north east Frontier Agency, seeds were sown in all centres after necessary treatment. The germination percent is 50 and plant percent is 40.

1395 Agboola, D.A. 1993. **Effect of seed size on germination, seedling growth and dry matter accumulation in some tropical tree species**. Malaysian Forester 56(1/2): 61-71.

The rate of germination in *T. grandis* was faster for small seeds than large seeds. The Net Assimilation Rate and the Leaf Area Ratio were higher in seedlings of *T. grandis* raised from large seeds. Relative Growth Rate was higher in seedlings of *T. grandis* raised from small seeds.

1396 Agboola, D.A. 1998. **Effect of saline solutions and salt stress on seed germination of some tropical forest tree species**. Revista de Biologia Tropical 46(4): 1109-1115.

Saline solutions of six salts used had highly significant effects on seed germination in most of the tree species. Sodium sulfate permitted germination of the seeds of *Tectona grandis* presoaked in 0.2 M solution for 48 h. Solution of potassium permanganate favored the germination of seeds of *T. grandis*. Seeds of *T. grandis* were reported salt tolerance.

1397 Agboola, D.A. 2000. **Studies on the germination inhibitors in the fruits of four tropical tree species**. Global Journal of Pure and Applied Sciences 6(1): 27-30.

Aqueous extracts of intact fruits of tree species including *Tectona grandis* contained germination inhibitors, which when applied to guinea corn grains inhibit their germination.

1398 Agboola, D.A; Etejere, E.O. 1991. **Effect of relative humidity during seed storage on longevity of seeds of six forest tree species**. Nigerian Journal of Botany 4: 23-32.

The study include the species *Tectona grandis*.

1399 Agboola, D.A; Etejere, E.O; Fawole, M.O. 1993. **Effect of orientation and soil types on germination of seeds of some tropical forest tree species**. Seed Research 21(1): 13-20.

Germination of *Tectona grandis* was significantly higher in loamy soil than in washed sterile river sand or non-sterile river sand. In *Tectona grandis* germination was significantly slowed down when the hilum/micropyle was inverted.

1400 Armitage, H.P. 1896. **Germination of teak seed**. Indian Forester 22(11): p438.

Reports the Ceylon experience in which, during dry and fine weather, the seeds are spread on ground on a mat 4" thick, constantly watered in sun and germination started in three days. The germinating seedlings are pricked out into nursery, watered twice daily and first pair of leaves appeared in 15 days.

1401 Bagchi, S; Emmanuel, C.J.S.K; Boisson, C. 1983. **Germination studies in *Tectona grandis* Linn.f.** Myforest 19(4): 209-213.

Fruits collected from plus trees in Kerala, soaked and dried once and sown. Germination and numbers of chlorophyll-deficient mutants recorded until 54 days after sowing. Germination varied from 15.5 to 106.7 percent. Seedlings from 5 of the plus trees were chlorophyll deficient or albino. The results suggest that inbreeding is occurring in a normally cross-pollinating species and possible reasons for this are discussed.

1402 Bamrungrars, P. 1964. **Comparison of the germination of seeds soaked in 5 percent of sulphuric acid for different periods**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Results indicated soaking for 40 minutes gives best germination but not significant among the treatments.

1403 Banik, R.L. 1977. **Studies on grading of teak fruits - 1. Fruit size is a factor in germination of teak seeds**. Bano Biggyan Patrika 6(1): 1-7.

The lower germination rate of the smaller fruits appeared to be largely due to their lower seed content. It is recommended that teak fruits of less than 14 mm diameter should not be used in nurseries.

1404 Banik, R.L. 1978. **Studies on grading of teak fruits. II. Combined effect of fruit weight and size in the production of seedlings**. Bano Biggyan Patrika 7(1/2): 20-29.

Results of germination tests showed that size is the primary factor determining quality through its relation with seed number demonstrated earlier.

1405 Bannerjee, K.K. 1942. **An attempt on quick germination of *Tectona grandis* seeds**. Indian Forester 68: 240-244.

The method include after 36 hours of soaking in a pond, the seeds are spread on bamboo mats and are watered. Some 50 percent found germinated.

1406 Bapat, A.R; Phulari, M.M. 1995. **Teak fruit treatment machine - a prototype - II**. Indian Forester 121(6): 545-549.

This paper describes a second prototype of fruit treatment machine, which enables the easy, rapid and cheap processing of batches of 10-13 kg of pre-soaked fruits.

1407 Barrantes, G; Salazar, R. 2000. **Commercialization of seeds in the forestry seed bank of the Agricultural Centre of the Hojancha Area (CACH)**. (Spanish). II Simposio sobre avances en la produccion de semillas forestales en America Latina: Memorias, Santo Domingo, Republica Dominicana, 18-22 de octubre 1999: 243-247. Centro Agronomico Tropical de Investigacion y Ensenanza (CATIE); Turrialba; Costa Rica .

Between March 1997 and May 1999, 19,777 kg seeds were available from the CACH seed bank at Guanacaste, Costa Rica. The most demanded species were *Tectona grandis* of 13,173 kg.

1408 Bedell, P.E. 1989. **Preliminary observations on variability of teak in India**. Indian Forester 115(2): 72-81.

The results are given of pretreatment and germination studies with thirty six Indian seed provenances. Treatments tested included alternate soaking in water and drying for 1 month, soaking in Sach's nutrient solution and drying for one month and no treatment.

1409 Bedell, P.E; Vijayachandran, S.N. 1994. **Observations on fruit and seeds of individual clones of Walayar teak seed orchard**. Journal of Tropical Forestry 10: 107-113.

1410 Bhumibhamon, S. 1973. **Seed problems in Thailand**. IUFRO Symposium, Bergen, Norway, 4-14 September 1973: 17p.

The paper describes seed problems of species used in afforestation and reforestation programmes of Thailand and factors like age of trees, vigour, and other environmental factors influencing the production of seeds. The existing methods of seed collection, processing, extraction and storage for various species are described. Work done and research projects at the Thai-Danish Teak Improvement Centre, specially on teak seed storage, germination methods and seed orchard are also discussed.

1411 Bhumibhamon, S; Ponoy, B; Chaisurisri, K. 1981. **Germination complex of teak fruits**. (Spanish; English). Instituto Nacional de Investigaciones Forestales, Mexico 35: 253-264.

Fruits were collected from five natural stands in Thailand. Fruits damage, fruits weight, number of seeds/fruit, seed size and germination percent is reported for seed from 1-, 2-, 3-, or 4-seeded fruits. Aqueous or alcohol extracts of teak fruit mesocarp inhibited the germination of rice grains and pine seed, indicating the presence of a phytocide.

1412 Bingchao, K. 1995. **Relationship between teak seeding density and seedling yield and quality**. Forest Research, China 8(4): 351-359.

1413 Blanford, H.R. 1921. **Preparation of teak seed for early germination**. Burma Forest Bulletin 1 (Silviculture Series): 7p.

Describing the methods followed by M/s Dawkins, Milner and Moodie buried seed shows good results. The time and method of dibbling buried seed is recommended. Soaking in a stream for 10 days in sacks as a last resort and burying for one month and dibbling seed is recommended.

1414 Blanford, H.R. 1931. **Experiments in connection with sowing and planting teak in taungya plantations**. Burma Forest Bulletin 24 (Silviculture 14): 15p.

Discussed the results of the experiments done to examine teak sowings in different nursery sites, different times of sowing and with different seed pretreatments to promote early germination. Another series of experiments are carried out by direct sowing and planting in taungya plantations.

1415 Boonkird, S. 1973. **Germination test on teak seeds from fertilized and unfertilized mother trees**. Proceedings of IUFRO Seed Symposium, Bergen, Norway, 4-14 September 1973, II Paper 3: 1p.

It was observed that germination percentage of the seeds from the unfertilized mother trees were 24.6 percent, 24.8 percent and from fertilized plots varied from 32.4 percent, 33.6 percent and 37.8 percent.

1416 Boonkird, S. 1973. **Germination test on seeds from V-4-clone at Mae-Moh teak seed orchard**. Proceedings of IUFRO Seed Symposium, Bergern, Norway, 4-14 September 1973, II, Paper 4: 1p.

Seeds from V-4 clone in a 5 year old seed orchard of Teak Improvement Centre at Mae-Huad, Ngoa, Thailand, were used in a four replicate randomized block germination test gave an average germination of 51.8 percent.

1417 Boonmuang, B. 1961. **Germination of teak seeds buried at different depths and comparison of their growth**. Student Thesis. Kasetsart University, Bangkok.

Seed sown on surface of seed bed, just below surface and 2.5 cm below surface indicated surface sowing is best with 9.9 percent germination and below surface 5.3 percent and completely buried 1.8 percent germination. Growth of the three treatments are 18.7 cm, 15.7 cm and 9.10 cm respectively.

1418 Boonyasirkul, C. 1964. **Comparison of germination of teak seeds after soaking in various different concentration of acid**. (Thailand). Student Thesis. Kasetsart University, Bangkok.

The results indicated treatment with different acids or using different concentrations for treatment is not different from water treatment as far as germination is concerned.

1419 Bourke, D.R.S. 1914. **Germination of teak seeds**. Indian Forester 40(10): p519.

The author suggests that teak seed improves and germinates better by keeping for one or two years. Describes an experiment with profuse germination of two years old stored seed.

1420 Bryndum, K. 1966. **The germination of teak**. Natural History Bulletin of the Siam Society 21(1/2): 75-86.

The Teak Improvement Centre experiments on the germination of teak and programme of work for the Thai-Danish Teak Improvement Centre, at Mae-Huad, Northern Thailand are described. Discusses the slow and sporadic germination of teak seed and gives results of nursery experiments showing that the germination rate can be increased considerably by removing the exocarp from the fruit.

1421 Butranar, M. 1962. **Germination rate of teak seeds determined by oven method of various temperatures**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Results of the experiments carried out with different oven temperatures using seed size of 11.5 mm are presented here. The average germination is 6.39 percent and average survival of seedlings is 99.13 percent.

1422 Caldeira, S.F; Mendonca, E.A.F de; Diniz, N.N. 2000. **Characterization and quality evaluation of teak (*Tectona grandis* Linn.f.) fruit produced in Mato Grosso, Brazil**. (Portuguese). Revista Brasileira de Sementes 22(1): 216-224.

Fruits of 13 seed lots of *T. grandis* from three seed producing areas from Brazil were characterized. Properties of moisture content, fruits weight and number of fruits per kg are studied. The lots showed an average of 1/3 of fruits with no seeds and 74.3 percent with one seed.

1423 Chacko, K.C. 1998. **Termite aided mesocarp removal of teak (*Tectona grandis* Linn.f.) fruits for enhanced germination and cost-effective seed handling**. Indian Forester 124(2): 134-140.

Termite-aided mesocarp removal of teak fruits is an efficient pre-sowing treatment for early and enhanced germination. In a test at Kerala Forest Research Institute, fruits were left heaped in open-ground infested with subterranean termites, *Odontotermes guptai*, mixed with dry twigs and kept sufficiently moist. The termites ate away the entire mesocarp within 13 days leaving behind fruits with a stony endocarp.

1424 Chacko, K.C; John, S.K; Asokan, A.M. 1997. **Evaluation of some pre-sowing treatments for germination of teak (*Tectona grandis* Linn.f.) fruits**. Annals of Forestry 5(1): 55-61.

The treatments included alternate wetting and drying for 2-7 days, soaking in cowdung solution followed by storage in wet gunny bags, boiling in water and cooling and steaming under open and closed conditions. The effect of paddy straw and twigs of amla as mulching materials on seedbeds were also compared. Wetting and drying for 7 days and soaking in cowdung solution for 24 hours are recommended for enhancing germination of teak fruits.

1425 Champion, H.G. 1933. **Germinating teak seed**. Indian Forester 59(3): p191.

Reported the case of the method evolved for germinating teak seed at the Forest Research Institute, Dehra Dun.

1426 Chantrakaew, K. 1963. **Study of germination percentage of teak by soaking in running water for various periods**. (Thai). Student Thesis. Kasetsart University, Bangkok.

No germination has been reported in the case of soaking in running water for 20 days and for 15 days. 0.5 percent germination got in the case of soaking in running water for 10 days and for 5 days gave 2.5 percent germination and control in running water for 5 days gave 15.75 percent germination.

1427 Chaplin, G.E. 1988. **Notes on seed testing techniques for six major species**. Forestry Division, Solomon Islands, Forest Research Note 56-23-88: 6p .

Techniques for germination testing, pretreatment required and germination characteristics and problems are described for species including *Tectona grandis*.

1428 Chaplin, G.E; Gua, B.E; Poa, D.N. 1987. **Seed production of seven major plantation species since 1984: Implication for future objectives**. Forest Division, Solomon Islands, Forestry Note 19-3-87: 5p.

Data on seed collection and seed sources and stands are given for seven major Solomon Islands species including *Tectona grandis*. The implications for future seed supply are discussed and the importance of improvements in seed quality emphasized.

1429 Charoenphaibool, W. 1962. **Comparison of the germination of teak seeds soaked in different concentrations of Acetic acid**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The control and 1 percent concentration treatment are significantly different from 20 percent and 30 percent concentration treatments.

1430 Chaturvedi, M.D. 1942. **Germination of teak seed**. Indian Forester 68: p457.

A method is described for hastening the germination of teak seeds by spreading them on a 1-inch-thick layer of coarse sand resting on loosely packed grass and twigs over a brushwood foundation, and then covering the seed with a thin layer of rich forest soil. The bed is soaked with water every evening.

1431 Chen, C.T; Yang, K.C. 1969. **Experiment on hastening germination of teak seeds**. (Chinese). Quarterly Journal of Chinese Forestry, Taipei 2(2): 59-65.

Treatment with hot sand gave a mean germination of 44.5 percent, alternate soaking and drying 29.5 percent, scarification of the pericarp 20.8 percent, storage in the ground 18.8 percent and controls 9.4 percent germination.

1432 Chobkai, S. 1962. **Comparison of the germination of teak seeds soaked in different concentration of Sulphuric acid**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Teak seeds soaked in sulphuric acid 10, 20, 30, 40 percent concentration gave very good germination with 10-20 percent concentrations but there is no significant differences between other treatments and control.

1433 Choldumrongkul, A; Pipitvitaya, S; Ratanaporncharern, W. 1999. **Germination of teak (*Tectona grandis* Linn.f.) pollen from different crown directions**. (Thai). Kasetsart Journal, Natural Sciences 33(3): 330-334.

Germination of teak pollens collected from different crown directions of north, south, east, west and in the central part of the crown were investigated. Germination percentage of pollen collected from southern direction was lowest.

1434 Chuntanaparb, L. 1962. **Comparison on the germination percentage between different size of teak fruits gathering from Prae an Lampang**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Two seed lots of 2500 seeds from each provenance were divided into five seed class sizes (1) below 8 mm; (2) 8-11 mm; (3) 11-14 mm; (4) 14-17 mm; (5) 17 mm and over. The seed from Prae provenance is not significantly different for different classes and in Lampang seed lot size class 17 mm and over is best for germination.

1435 Dabral, S.L. 1976. **Extraction of teak seeds from fruits, their storage and germination**. Indian Forester 102(10): 650-658.

A method of extraction is described that uses a modified nut-cracker to split the teak fruit in four longitudinal planes. Fungicide-treated seeds gave 54 percent germination after two months storage. Seeds germinated at temperatures between 25 deg C and 40 deg C, with an optimum at 30 deg C. Soaking of seeds before sowing reduced germination.

1436 Dabral, S.L. 1976. **Emptiness in teak (*Tectona grandis* Linn.f.) fruits**. Indian Forester 102(4): 247-253.

Fruit development from flowering to fruit maturity was studied on teak trees in Chandrapur district, Maharashtra. Fertilized fruits in the early stages of development contained an ovule in each locule. Emptiness developed at the time of lignification of the endocarp and was not related to locule size.

1437 Damale, D.N. 1901. **Germination of teak seed**. Indian Forester 27(10): p553.

A short note on a method of germination of teak in hill-lands without watering the seed or seedlings. One year old seed is sown in well pulverised earth in May germinates with first downpour of rain within a week. Seedlings though leaf less in hot season do not die.

1438 Darmono, R; Corryanti, T.W.N. 1996. **The effect of long-term storage of teak seeds, testing of methods**. (Indonesian). Duta Rimba 20(187/188): 38-46.

Germination tests were carried out in open nursery beds at Mae Tha Seed Orchard after five storage treatments like keeping the seeds in jute and storing under a shed, keeping in a sealed container in a cold room, keeping in aerated bags in a cold room, keeping in a sealed container in a seed storage room and keeping in aerated bags in a seed storage room.

1439 Das, G. 1896. **Germination of teak seed at Jodhpur**. Indian Forester 22(9): p353.

Seed buried in a pit, taken out and sown in nursery and watered, which germinated and seedlings have come up.

1440 Denoga, A. 1936. **On germination of teak (*Tectona grandis*, Linn. F.)**. Makiling 15(2): 1936-1937.

1441 Denoga, N. 1939. **Germination of teak**. Philippine Journal of Forestry 2: 173-183.

The best results were obtained with surface sowing, soil treatments with 1 part ash to 2 or 5 parts clay-loam, and seed storage for 20 to 60 days in shaded pits.

1442 Dent, T.V. 1948. **Seed storage with particular reference to the storage of seeds of Indian forest plants**. Indian Forest Records (n.s.) 7(1): 124p.

Gives a comprehensive account on all aspects of seed storage together with a discussion on the important items of seed storage, seed viability, dormancy, germination and testing of seed. Teak is one of the many species included.

1443 Dharmalingam, C; Masilamani, P. 1997. **Radiography technique for testing the quality of teak (*Tectona grandis* Linn.f.) seeds**. Bangladesh Journal of Forest Science 26(2): 51-55.

Teak drupes from Tamil Nadu and Thailand differed in size and weight both within and between seed lots. Radiographs showed the occurrence of 4, 3, 2 and 1 seeds in the tetracarpillary ovary in the frequency of 1, 5, 19 and 48 percent respectively with 27 percent empty drupes.

1444 Dhyansagar, V.R; Kothekar, V.S. 1982. **Problem of teak seed germination**. Indian Journal of Forestry 5(2): 94-98.

Seeds in lots of 200 were irradiated with 0, 10, 15 or 40 kR doses of gamma rays and sown in the field. Germination percentages were 8-10, 25, 30 and 20 respectively. The population raised from treated seeds showed chlorophyll chimaeras and a broad spectrum of morphological variations.

1445 Dontri, S.I. 1962. **Study of the germination of teak seeds in sand with different level of Calcium application**. (Thai). Student Thesis. Kasetsart University, Bangkok.

1446 Dontri, S.I. 1970. **Teak seed treatment by soaking in water**. Proceedings of the 3rd National Forestry Conference, Bangkok.

1447 Duangratana, K. 1966. **Study on the germination of teak fruits and growth of seedlings under different intensities of light**. (Thai). Student Thesis. Kasetsart University, Bangkok.

1448 Eidmann, F.E. 1923. **Practical results of germination on research in teak and several other timbers**. Tectona 26: 423-426.

1449 Eidmann, F.E. 1934. **Germination of teak (*Tectona grandis* Linn.f.)**. (Dutch; German). Tectona 27(4): 233-287.

Influence of the age and quality of mother trees and size of fruit upon seed quality and ease of germination was investigated in Java. Data on yield of fruits, size and their germination in different months was given and recommendations are made on seed storage and viability was observed to last for one year.

1450 Emmanuel, C.J.S.K; Dharmaswamy, S.S. 1991. **Seed source variation in storage life of teak seeds**. Silvae Genetica 40(5/6): 249-250.

Seeds of teak of Karnataka, Kerala and Tamil Nadu were stored under three different conditions: cold storage at 5°C, storage in a gunny bag and storage in a polyethylene bag. Storage in polyethylene bag gave the best results for seeds from Tamil Nadu and Kerala and germination of Karnataka seeds was similar for all three storage methods.

1451 FAO. 1955. **Tree seed notes: Part 2 *Tectona grandis***. FAO Forest Development Paper 5: 337-339.

Gives notes on teak along with other species.

1452 FAO. 1975. **Report on the FAO/DANIDA training course on forest seed collection and handling, Chiang Mai, Thailand, 17 February-13 March 1975. 2 vols**. 453p. FAO, Rome.

Covered theoretical and practical aspects of seed collection and handling. Lectures were on forestry in Thailand, flowering and seed development, seed collection, seed extraction, storage and testing, improved seed sources and seedbeds and sowing. Case studies are presented on different species including *Tectona grandis*.

1453 Ferguson, J. 1877. **Memorandum on growing seedlings from teak seed planting out etc**. Indian Forester 3(2): 112-113.

1454 Ferraz AC de, O; Dal Fabbro, I.M; Silva J.M da; Amaral R do; Rodrigues, A.L.G; Penteado, S.R. 1998. **Design of a processing machine for teak fruits to extract seeds**. (Portuguese). Engenharia Agricola 18(1): 52-58.

The machine was designed based on the physical properties of the fruit. The system is able to crack 13 kg of fruit per hour. Construction details as well as capacity are presented.

1455 Forest Department, Papua and New Guinea. 1959. **Storage of teak seed**. Report of De-

partment of Forestry, Papua and New Guinea 1959/60: 26p.

An experiment was made to measure rate of fall in viability. Preliminary results indicate that germination begins to fall after storage for 6 months.

1456 Forest Department, Trinidad and Tobago. 1954. **Germination tests**. Report of Forest Department, Trinidad and Tobago 1952: 15-16. Forest Department, Trinidad and Tobago.

Germination tests of 13 species were made on sterile blotting paper in Petri dishes. Teak gave poor results but good correlation between laboratory and field percentages of germination was obtained. Seed in a glass jar with $CaCl_2$, or in a refrigerator gave good results.

1457 Garudachellam, C.P. 1915. **Germination of teak seeds**. Indian Forester 41(10): p383.

Reported the method of seed germination of teak by soaking in water.

1458 Ghosh, R.C; Singh, R.P. 1973. **Production forestry and role of seed management-a report on India**. Proceedings of IUFRO Seed Symposium, Bergen, Norway, 4-14 September, Vol. II Paper II: p13. Royal College of Forestry, Stockholm.

A country report on India giving teak forestry achievements and seed problems and measures taken by forestry service to meet the huge demands of seed for plantation forestry. It is reported that upto 1968-69 in India 2,85,500 ha. of teak plantation were raised and a planting target of 70,000 ha. was put for 1974-79 plan period.

1459 Gopal, M; Pattanath, P.G; Adarsh Kumar. 1972. **A comparative study of germination behaviour of *Tectona grandis* of some Indian provenances**. Proceedings of Symposium on Man-Made Forests in India, 8-10 June 1972, Society of Indian Foresters, Dehra Dun. Forest Research Institute, Dehra Dun.

The morphological variations and physiological differences that affect germination capacity of teak seeds of five Indian provenances have been recorded and pretreatment for the improvement of germination has been prescribed.

1460 Gopikumar, K; Mahato, K.C. 1993. **Germination and growth behaviour of selected tree species in the nursery**. Indian Forester 119(2): 154-156.

Sixty nine percent germination was recorded for *Tectona grandis*. Girth growth was the least variable parameter between seedlings. Height and number of leaves were significantly correlated with root length and numbers.

1461 Grewal, J.S; Kumar, A; Gaikwal, S.R. 1993. **Teak fruit treatment machine - a prototype**. Indian Forester 119(3): 252-254.

A machine is described that has been developed by Maharashtra Van Sanshodhan Sanstha for removing the mesocarp from teak fruits before sowing. The treated fruits can then be stored.

1462 Gupta, B.N; Kumar, A. 1976. **Estimation of potential germinability of teak (*Tectona grandis* Linn.f.) fruits from twenty three Indian sources by cutting test**. Indian Forester 102(11): 808-813.

Sun dried teak fruits from twenty sources were broken with a light hammer. Empty fruits formed the largest group. Among fruits with seeds, the majority contained only one; 3- and 4-seeded fruits were relatively rare.

1463 Gupta, B.N; Pattanath, P.G. 1975. **Factors affecting germination behaviour of teak seeds of eighteen Indian origins**. Indian Forester 101(10): 584-588.

Reports the results of four treatments: control, soaking in water, soaking in Sachs nutrient solution and removing the mesocarp but leaving the endocarp intact - on the emergence of seedlings from fruits of *Tectona grandis*. Treatment with nutrient solution increased seedling production by 6 to 53 percent, soaking in water also increased seedling production.

1464 Gupta, J.N. 1937. **Seed weights, plant percent for forest plants in India**. Indian Forest Records 11(5).

1465 Hardjowasono, M.S. 1931. **Weight and volume of various species of fruits and seeds**. (Dutch; English). Tectona 24(4): 382-402.

The weight of 1000 teak fruits is reported as 562 to 631 g. and volume 1.920 to 2.210 cm3. The number of seeds per Kg. vary from 1600-1800 and per litre 450-520 or per kerosene tin from 8400-9650.

1466 Hardjowasono, M.S. 1942. **Weight and volume of fruits and seeds**. Tectona 36 (1943): p382.

1467 Hodgson, C.M. 1900. **On pretreatment and germination of teak**. Indian Forester 26: p279.

Slight charring has been found to stimulate germination. Soaking for 24 hours in luke-warm water prior to sowing induced germination in 12-24 hours. Another method consists in filling a pit with alternate layers of seeds and earth 1" thick, cover it with earth and kept it well drenched with water for a fortnight and watered until germination begins. A successful method in Ceylon is to spread seed in layers of 4" thick on a mat and keep it constantly watered, germination starts in 3 days, and the germinating seeds are removed daily and sown in the nurseries.

1468 Holmes, C.H. 1954. **Seed germination and seedling studies of timber trees in Ceylon**. Ceylon Forester 1(3): 3-51.

Data of the germination tests are presented for teak and several other species such as germination periods and growth rate of seedlings.

1469 Hossain, M.K; Khan, B.M; Koirala, B. 2001. **Effect of presowing treatments on *Tectona grandis* Linn.f. seeds and initial seedling development in the nursery**. Proceedings of the IUFRO Joint Symposium on Tree Seed Technology, Physiology and Tropical Silviculture, Laguna, Philippines, 30 April-3 May 2001. Connor, K; Beardmore, T; Tolentino, E.L; Carandang, W.M., Eds: 23-28. Training Center for Tropical Resources and Ecosystems Sustainability (TREES), Laguna.

It is reported that seeds soaked in concentrated sulphuric acid for seven minutes followed by cold water washing provides the highest germination. This was followed by 48 percent and 44 percent germination in seeds treated with concentrated sulphuric acid for five minutes and soaking the seeds in cold water for 48 hours following wet pit storage for 12 days respectively.

1470 Howard, S.H; Champion, H.G. 1928. **Note on weights of seeds**. Indian Forest Bulletin 41.

Gives the seed weight and plant percent for teak and other important Indian tree species.

1471 Hung, L.B. 1958. **Preliminary study on the seed of teak**. Bulletin of Taiwan Forest Research Institute 59: 10p.

Studies were made on the number of seeds per nut, their germination and survival. The mean number of seeds per 100 nuts was 171 and the mean weight of 100 nuts 67.5 g.

1472 Indira, E.P; Chand Basha, S. 1999. **Effect of seeds from different sources on germination and growth in teak (*Tectona grandis* Linn.f.) nursery**. Annals of Forestry 7(1): 39-44.

Nursery experiments conducted at the Kerala Forest Research Institute nursery showed significant differences between and within seeds collected from four groups of teak trees such as plus trees, plantation trees, seed stands and seed orchards with regard to percentage germination and production of total and plantable seedlings. There were highly significant correlations between percentage germination and total and plantable seedlings.

1473 Indira, E.P; Chand Basha, S; Chacko, K.C. 2000. **Effect of seed size grading on the germination and growth of teak (*Tectona grandis*) seedlings**. Journal of Tropical Forest Science 12(1): 21-27.

The effect of size grading of teak seeds collected from natural forests, plantations, seed stands and orchards and plus trees on seedling production and growth was studied at the Kerala Forest Research Institute. The nursery experiments showed that seed size did not have any influence on seedling survival and growth. But seeds of 9 mm diameter had a low germination percentage.

1474 Indira, E.P; Chand Basha, S; Chacko, K.C; Krishnankutty, C.N. 2001. **Effect of different sowing methods and seed rates on germination and growth of teak seedlings**. Indian Journal of Forestry 24(1): 93-96.

The paper presents the result of an experiment conducted at the Kerala Forest Research Institute to study the effect of sowing methods and seed rate on germination and growth of teak seedlings. Broadcasting was found better than dibbling. The study also revealed that there is no significant difference between five seed rates tested with regard to percentage of germination beyond a limit, total and plantable seedlings. Seed rate reduces the survival rate.

1475 Jagat Singh. 1925. **The germination of teak seed**. Indian Forester 51(8): 421-422.

Reports on a successful method of germination by burying the seed in a pit for a period of one year. Bottom of the pit covered with straw and leaves and then filled with Burma teak seed covered again with straw and leaves and closed. Coating of the seed was eaten away and after soaking for 24 hours and sowing in May end germination was over 95 percentage.

1476 Jagat Singh. 1926. **The germination of teak seed**. Indian Forester 52(1): 30-32.

Replies to Mr. Tuggersee on objections for pit method of treatment in heavy rainfall areas and considers open air Kanara method is expensive and also advocates transplanting method over direct sowings on considerations of economy of seed and finances.

1477 Jalil, P. 1994. **Effect of storage containers on the viability of *Tectona grandis* seeds from different provenances of Madhya Pradesh**. Vaniki Sandesh 18(4): 32-37.

It is found that teak seeds retained viability for longer and germinated better when stored in air-tight metal containers rather than in loose bags. Germination increased over the first six months of storage and then started decreasing. Seeds collected from more moist localities had a higher initial germination percentage but lost viability faster.

1478 Jalil, P; Shukla, P.K. 1994. **Growth performance of teak (*Tectona grandis*) seedlings raised from the seeds of improved genetic resources**. Vaniki Sandesh 18(1): 1-5.

In Madhya Pradesh.

1479 Jayasankar, S; Babu, L.C; Sudhakara, K; Unnithan, V.K.G. 1999. **Provenance variation in seed and germination characteristics of teak (*Tectona grandis* Linn.f.)**. Seed Science and Technology 27(1): 131-139.

A trial of teak from seven provenances in Kerala was established at Vellanikkara, Kerala. Seed size varied significantly among provenances and Parambikulam recorded the highest values. Konni recorded the highest germination percentage, peak value and mean daily germination. Heritability was the highest for germination percentage followed by seed weight.

1480 Jones, N; Das, S. 1979. **A programme for the procurement of improved forest tree seeds in Bangladesh**. Bano Biggyan Patrika 8(1/2): 71-80.

Progress during 1976-79 in the selection of seed stands and provisional plus trees, mapping of the natural distribution of the four indigenous species and the establishment of clonal seed orchards of G. arborea and *T. grandis* are described.

1481 Kaewkamnerd, W. 1962. **Comparison of the germination of teak fruits soaked in different concentrations of Hydrochloric acid**. (Thai). Student Thesis. Kasetsart University, Bangkok.

1482 Kaewsingha, A. 1963. **Effect of gamma ray irradiation on the germination of teak seeds**. (Thai). Student Thesis. Kasetsart University, Bangkok.

A seed lot of 1400 seeds were treated with gamma rays from 60 source activity - 20 curies with strengths of 5, 10, 20, 40, 60 and 100 thousand (Roeutgens) R. The germination percent of seed lot treated with gamma rays after sowing are highly significant after 65 days and for others, 32.5, 26, 25, 19.5, 12.5 and 7.5 percentages respectively for irradiated seed.

1483 Kalshoven, L.G.E. 1922. **Notes on forest zoology: 2. Teak fruits spoiled by birds and mammals**. (Dutch). Tectona 15: 684-693.

Among birds, green parrots, small and large squirrels, monkeys, mice, rodents are listed to be causing damage to teak fruits either on top of tree or after falling to the ground.

1484 Kamra, S.K. 1973. **Forestry seed problems of some developing countries in Asia**. Sri Lanka Forester 11(1/2): 5-12.

Discusses the problems of obtaining good-quality seed of the various important tree species including teak in India, Sri Lanka, Bangladesh, Thailand, Korea and the Philippines. The most important problems concern seed testing, seed certification and seed storage and stressed the need for international action to provide financial and technical assistance.

1485 Kamra, S.K. 1973. **X-Ray radiography of teak seed (*Tectona grandis*. L.)**. Proceedings of IUFRO Working Party S2.01.06 on seed problems, International Symposium on seed processing, Bergen, Norway 4-14 September 1973: 13p.

This investigation was performed to find out if X-ray radiography could be utilized for determining the number of seeds in the fruit of teak and for studying their degree of development. The radiographs showed that the number of seeds in the fruit could be determined reliably from them. On an average about 48 percent of the fruits contained one fully developed seed and about 16 percent two such seeds. Seeds were classi-

fied into fully developed, medium developed and poorly developed or rudimentary.

1486 Kamra, S.K. 1989. **Collecting, processing, testing and storage of forest seed**. Strengthening the capacity of forest seed production and supply in Vietnam, VIE-86-026, Field Document 2: 66p. Food and Agriculture Organization, Rome, Italy.

Gives the details of different species including teak.

1487 Kamra, S.K; Meyer, W.W; Wegelius, C. 1973. **Stereo-radiography for increased information and accuracy in seed quality testing**. Proceedings of IUFRO Working Party S2.01.06 on Seed Problems, International Symposium on Seed Processing, Bergen, Norway 4-14 September 1973: 8p.

This paper describes the Stereoradiographic technique as a supplement to the X-ray contrast method in seed quality testing. The technical details of method, x-ray film used, exposure time and apparatus are described.

1488 Kandya, A.K; Kandya, S; Turnbull, J.W. 1990. **Seed research on *Tectona grandis* in India**. Tropical tree seed research. Proceedings of an International Workshop, Forestry Training Centre, Gympie, Australia, 21-24 August 1989. ACIAR Proceedings Series 28: 142-146.

A review of the literature since 1900, divided into sections on presowing treatments, provenance trials, emptiness of fruits and seed requirements for plantation programmes.

1489 Kayarnkit, C. 1967. **Germination rate of teak fruits gathering from different age class of mother trees**. (Thai). Student Thesis. Kasetsart University, Bangkok.

1490 Keiding, H; Knudsen, F. 1974. **Germination of teak seed in relation to international provenance testing**. Forest Tree Improvement, Arboretet Hoersholm 7: 19-29.

Reports results of germination tests in Denmark on two provenances of *Tectona grandis* seeds from India. It is found that germination varied with the treatment given: seeds soaked for 48 hours gave better germination than those soaked for 72 hours and seeds with the exocarp removed gave better germination than those with the exocarp intact. There were marked differences between the provenances in the germination.

1491 Kharkhong, S. 1963. **Study of teak seed germination by oven-heated, treatment for different periods**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Oven heated seeds at 50 degree C for 1, 2, 3 and 4 hours, then soaked in cold water for 4 hours. Sown in sand and germinated as below 26.5 percent, 24.25 percent, 32.75 percent and 25.75 percent.

1492 Khayankit, Ch. 1967. **Determining the seed germination and seedling survival in different age classes of teak plantations**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Seeds from 5, 10, 15, 20 and 24 years aged stands were used and indicated 20 years has the highest germination of 49.2 percent and 10 years has the lowest germination of 29.6 percent.

1493 Koshi, S. 1993. **Teak fruit germination - some basic studies**. Delhi, University of Delhi: 54p.

Teak fruit germination has been a vexed problem for forest departments. Several pregermination treatments have been evolved to promote teak fruit germination in the nursery. A study of relative efficacy of some twelve germination treatments are examined.

1494 Kramer, F. 1932. **An investigation of the germination of teak**. (Dutch; German). Tectona 25(1): 1-24.

1495 Krishna Murthy, A.V.R.G. 1973. **Problems of teak seed -1. Flower and fruit studies**. Proceedings of IUFRO Symposium on Seed Problems, Bergen, Norway, 4-14 September 1973, Vol. II, 20: 17p.

A review paper on teak summarising the knowledge of biology and physiology of teak flowering and fruiting, seed collection, seed storage, and related matters, with special reference to their effect on viability and germination potential of teak seed are discussed and research to be undertaken is outlined.

1496 Krishna Murthy, A.V.R.G. 1973. **Problems of teak seed-2. Germination studies**. Proceedings of IUFRO Symposium on Seed-Problems Bergen, Norway, 4-14 September, Vol.II, 21: 24p.

A review paper on germination of teak fruit and germination problems as effected by seed dormancy and after-ripening proc-

ess, pre-sowing treatment, intensity of sowing, method of sowing and position of seed in seed bed, seed weight, seed diameter, viability of stored teak seed in relation to weight and diameter and effect of other factors like light, temperature, thickness of covering and age of mother tree etc. are discussed.

1497 Kulpracheep, Ch. 1963. **A comparison of the germination of teak seeds soaked in different concentrations of Hydrochloric acid**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Germination of 7.75, 15.75, 27.5, 9, 9.5 percentage was obtained respectively for control, 20, 15, 10, 5 percent concentration of Hydrochloric acid.

1498 Kumar, A. 1979. **Effect of fruit size and source on germination of teak (*Tectona grandis* Linn.f.) seeds**. Sri Lanka Forester 14(1/2): 58-63.

Fruits from five sources in Andhra Pradesh were graded by size and sown in moist sand. Cumulative germination is found increased with increasing fruit size in two provenances but showed no clear relation in the other three provenances.

1499 Lacharoch, S. 1963. **Comparison of the germination of teak seeds by soaking in different concentration of Acetic acid and planting them in two different media**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Germination of treated seed sown in clay is better than sand. Germination percent of seed treated with acetic acid is significant. Treatments studied are control, 2.5, 5, 7.5 and 10 percentage concentrations.

1500 Linden, A van der; Gonzalez Daimiel, A.P. 2000. **Status of the certification of forest seeds in Costa Rica**. (Spanish). Revista Forestal Centroamericana 32: 26-29.

Described he certification process for forest seeds as well as quality control methods for teak and *Gmelina arborea*.

1501 Liu, W.M; Liang, K.N; Pan, Y.F. 2001. **Effect of gibberellin on germination of teak**. (Chinese). Forest Research, Beijing 14(1): 41-46.

At a temperature of 35°C, gibberellin improved seed germination rate and speed. In the dark, a low concentration of gibberellin resulted in a higher germination rate.

1502 Mackenzie, J.A; Jones, N. 1998. **Towards synchronous germination of teak**. Workshop on Teak Seed, Tropical Forest Research Institute, Jabalpur, 28-31 May 1998.

1503 Mannan, M.A. 2000. **Studies on seed production, germination and storage of some plantation species in Bangladesh**. Bangladesh Journal of Forest Science 29(1): 61-66.

A study was conducted on 69 plantation tree species in Bangladesh to investigate their seed harvesting time, production, germination and storage. Seed pre-treatment was found necessary for enhanced germination of species with stony seed coat such as *Tectona grandis*.

1504 Manonmani, V; Vanangamudi, K. 2003. **Studies on enhancing seed germination and seedling vigour in teak (*Tectona grandis*)**. Journal of Tropical Forest Science 15(1): 51-58.

Several seed treatments were tried to improve the germination of fresh teak drupes taken from Kallar, Tamil Nadu. It is recommended that acid scarified drupes be soaked in 1 percent KNO_3 to enhance the germination and seedling vigour.

1505 Mascarenhas, L.P. 1915. **Germination of teak seeds**. Indian Forester 41(5): p147.

Reports of an experiment at Kakankote, Mysore with the following types of teak seed: seeds soaked in cowdung, seed without any treatment and charred seed from burnt teak forest. Charred seed found profusely germinated within fifteen days.

1506 Masilamani, P. 1996. **Seed technological studies in teak (*Tectona grandis* Linn.f.)**. Ph.D Thesis. Tamil Nadu Agricultural University, Coimbatore, India.

1507 Masilamani, P; Annadurai, K. 2003. **Influence of seed treatment on germination and initial seedling vigour of irrigated teak (*Tectona grandis* Linn.f.)**. Indian Journal of Forestry 26(1): 48-52.

A study was conducted to find out the effect of pre-sowing treatments on the germination and seedling vigour of irrigated teak. The drupes, subjected to pre-sowing treatments were germinated under open condition. Soaking and drying of drupes for 5 days at an interval of 12 hours followed by soaking in 2 percent Potassium Nitrate solution recorded 45 percent germination against 21.3 percent in the control.

1508 Masilamani, P; Dharmalingam, C. 1998. **Effect of orientation of drupe placement and depth of sowing on germination and vigour of teak**. Advances in Plant Sciences 11(2): 205-209.

The drupes were treated by alternate soaking and drying for 6 days at 12-h intervals and then sown in sand in pots at 1.5, 3 and 5 cm depths with the scar end in inverted, upright and horizontal positions. Placing the drupes with the scar end up or horizontally at a depth of 1.5 to 3 cm resulted in early and higher germination, more seedlings/100 drupes, higher root and shoot length, and greater dry matter production and vigour.

1509 Masilamani, P; Dharmalingam, C. 1998. **Germination improvement in teak (*Tectona grandis* Linn.f.) through forced ageing**. Current Science 75(4): p356.

A study was conducted to test the applicability of the accelerated aging technique for improving the germination and seedling vigour of teak. Drupes aged for 13 days showed 53 percent germination which was 35 percent more than the non-aged control drupes. It was suggested that forced aging could be used for commercial seedling production within a minimum period of time.

1510 Masilamani, P; Dharmalingam, C. 1999. **Effect of seed treatment with hydrogen peroxide on germination and seedling vigour of teak (*Tectona grandis* Linn.f.)**. Tropical Agricultural Research and Extension 2(1): 26-29.

The effect of pre-sowing treatments on the germination and seedling vigour of nine month-old teak drupes was studied. The drupes, subjected to pre-sowing treatments were germinated under open and mist chamber conditions. Soaking and drying of drupes for 5 days at an interval of 12 hours followed by soaking in 1.5 percent hydrogen peroxide solution resulted in 47 percent and 52 percent germination under the open and mist chamber conditions compared with 29 percent and 15 percent respectively in the control.

1511 Masilamani, P; Dharmalingam, C. 1999. **Germination behaviour of teak (*Tectona grandis* Linn.f.) drupes in fly ash incorporated medium**. Advances in Plant Sciences 12(1): 57-61.

The germination of fresh and 1-yr-old teak drupes collected from a 60-yr-old seed production area in Tamil Nadu was tested in nursery growing media incorporating fly ash. Before sowing drupes were pretreated by alternate soaking and drying at 12-h intervals over 6 days. The older drupes germinated and produced more and better quality seedlings than the fresh drupes in all the media.

1512 Masilamani, P; Dharmalingam, C. 1999. **Influence of seed treatment with potassium nitrate on germination and seedling vigour of teak (*Tectona grandis* Linn.f.)**. Indian Journal of Forestry 22(1/2): 1-6.

Soaking and drying of drupes for 5 days at intervals of 12 h followed by soaking in 4.5 percent potassium nitrate solution and germinating in the mist chamber gave the maximum germination of 52.0 percent.

1513 Masilamani, P; Dharmalingam, C. 2001. **Effect of accelerated aging on germination and seedling vigour of teak (*Tectona grandis*)**. Journal of Tropical Forest Science 13(1): 93-98.

Ageing was carried out in an ageing chamber maintained at 100 percent RH and 40 degree C. The fruit stones aged for 13 days showed 53 percent germination against 18 percent in the control in normal open condition after 28 days of sowing. Fruit stones in mist chamber gave 39 percent germination against 14 percent in the control after 11 days ageing.

1514 Masilamani, P; Dharmalingam, C; Annadurai, K. 2002. **Effect of natural ageing on germination and seedling vigour of teak (*Tectona grandis* Linn.f.) drupes**. Indian Journal of Forestry 25(1/2): 122-126.

The fresh, one and two year old drupes were allowed for germination under open and mist chamber conditions following soaking and drying of drupes for 6 days at an interval of 12 hrs recorded 8, 37 and 51 percent and 3, 40 and 50 percent germination respectively. Seedlings from one and two year old drupes also exhibited better seedling vigour than fresh drupes.

1515 Masilamani, P; Singh, B.G; Manimuthu, L. 1998. **Influence of collection methods and treatments of seeds on the germination and seedling vigour of teak**. Bangladesh Journal of Forest Science 27(2): 138-140.

Crown collected drupes did not germinate without preconditioning and preconditioned drupes gave 2.75 percent germination. Ground collected drupes gave 7.5 percent germination without preconditioning and 32 percent germination with preconditioning.

Seedling emergence, time to emergence and seedling growth and vigour were improved in preconditioned ground collected drupes.

1516 Mathew, J; Vasudeva, R. 2003. **Clonal variation for seed germination in teak (*Tectona grandis* Linn.f.)**. Current Science 84(8): 1133-1136.

Reported a negative association between age of the mother tree from which the clonal material was derived and the per cent germination of its progeny.

1517 Mishra, M. 1991. **Effect of tree growth on emptiness in teak fruits**. Vaniki Sandesh 15(3): 4-6.

There was less emptiness in fruits from trees of higher girth classes of 121-200 cm gbh and seeds from fruits from trees of higher girth classes also gave better germination.

1518 Mishra, M; Pal, M. 1997. **Physiological assessment of germinability of teak seed**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 68-69. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

The silvi-climate of the zone of seed origin, age of the mother trees, nutrient status of the seed, and presence/absence of inhibitory substance, etc. exert a strong regulatory effect on germination of teak seed. Pre-soaking of seed in water, acid or alkali for varying duration of time, alternate soaking and drying, brief exposure to gamma radiations, scarification, treatment with growth regulatory substances, etc. have been shown to improve the germination.

1519 Mistry, S. 1998 . **Large-scale patterns of seed dispersal**. Forest biodiversity research, monitoring and modeling. Conceptual background and Old World case studies: 197-219. F. Dallmeier; J.A. Comiskey, Eds. Man and the Biosphere Series Volume 20. Parthenon Publishing Group, Carnforth, UK.

Three examples of natural disturbance in a coastal evergreen forest in southern India, human disturbance and dispersal modes in a deciduous teak forest in western India, and seed dispersal modes across latitudinal and moisture gradients were used to illustrate seed dispersal modes at large scales.

1520 Mohd Zaki Abdullah; Ab Ghani, A.R; Mohd Noor Mahat; Amir Saaiffudin Kassim. 2002. **Germination of *Tectona grandis* progenies during nursery stage**. Journal of Tropical Forest Science 14(4): 552-554.

The germination percentages ranged from 2 to 74 percent with an average of 34.8 percent. The 34 tested plus trees could be grouped into two groups in terms of their germination ability; 13 individuals were found to give more than 50 percent germination while another 11 individuals produced less than 20 percent germination.

1521 Montero, N.C; Estevez, M. J.E. 1983. **Response of seeds of 16 tree species to various pregermination treatments**. (Spanish). Instituto Nacional de los Recursos Naturales Renovables y del Ambiente, Colombia, Investigaciones Forestales 14: 26p.

1522 Moss, S.G. 1892. **The germination of teak**. Indian Forester 18: 178-181.

Two morphological structures of teak leaf are described and the problem of artificial germination of teak seed is discussed. After 48 hours of soaking, seeds are sown.

1523 Msanga, H.P. 1992. **Influence of seed size on germination and early development of teak (*Tectona grandis* Linn.f.) seedlings**. NTSP Research Note 1: 9p. National Tree Seed Project, Morogoro, Tanzania.

1524 Mutanal, S.M; Patil, S.J; Hosalli, R.B; Nadagoudar, B.S. 2003. **Effect of tree age and diameter on germination of teak**. Karnataka Journal of Agricultural Sciences 16(3): 481-484.

A study was conducted to determine the effect of age and diameter at breast height classes of teak trees on seed germination. Seed weight, seed diameter and germination were higher in seeds collected from 25 year old trees grown in agroforestry systems compared to trees of the same age grown in plantations.

1525 Muttiah, S. 1975. **Some data on teak seed and further pregermination treatment trials**. Sri Lanka Forester 12(1): 25-36.

Germination tests showed that germination percentage is highest 2-4 months after collection. Seed pretreatment experiments showed that a treatment of 48 hours in stagnant water followed by alternate soaking and drying on a 12-hour cycle for 4 days gave the best germination.

1526 Ngulube, M. 1986. **Preliminary study on germination of pretreated seed of teak (*Tectona grandis*) under nursery conditions in Zomba, Malawi**. Forest Ecology and Management 17(2/3): 147-151.

The 96-h stream-soaked pretreated seed demonstrated superior followed by seed pre-treated by container soaking for 96 h and alternate drying and wetting for one week.

1527 Ngulube, M. 1988. **Effect of seed pretreatment on the germination of teak (*Tectona grandis* Linn.f.) in the nursery**. Journal of Tropical Forestry 4(2): 143-146.

Different methods of treatment of seeds for germination are described like soaking and alternate drying and soaking and removal of exocarp. More than 50 percent germination got after 14 months.

1528 Nisbet, J. 1907. **The sowing or dibbling of teak in Burma**. Indian Forester 33(1): 12-17.

Referring to Mr. Troupe's article on failure of teak dibblings, reports earlier teak dibblings of 1876 in Bwet Range of Tharrawaddy Division and comments on highly successful dibblings later confirmed by inspection of 1896. He recommends removal of teak rather than taungya method or artificial planting.

1529 Norman, J.C. 1977. **Influence of pre-sowing treatments and seed age on germination of seeds of teak (*Tectona grandis*)**. Ghana Forestry Journal 3: 11-14.

1530 Oliver, J.W. 1907. **The sowing or dibbling of teak seed in Burma**. Indian Forester 32(5): 241-243.

Reports large scale sowings in the same reserve of 1881. He reports in bamboo flowered areas - an intense fire after death of bamboo, if seed trees are present will give rise to extensive reproduction of teak without aid of artificial sowings.

1531 Osmaston, L.S. 1908. **Treatment of teak seed for germination**. Indian Forester 34: p534.

The method consists of filling a pit with teak seeds and covering the same with a layer of earth 1" thick and thoroughly watering every third day for six weeks. Then the seed is taken out and spread in sun for three weeks and the seed is sown with commencement of rains.

1532 Pakdee, P. 1961. **Comparison of the germination of teak seeds of different sizes**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Compared the germination performance of five different size classes of seeds.

1533 Panjamanondh, W. 1962. **Comparison of the germination of teak seeds soaked in hot water of different temperatures**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Seed soaked in hot water of different temperatures for 5 minutes when sown gave different percentage of germination.

1534 Pearson, R.S. 1905. **Note on germination of teak and other seeds**. Indian Forester 31(3): 168-171.

Describes three methods of treatment. The method of putting seed in layers one inch think in a pit with alternate layers of earth of same thickness is found good.

1535 Pearson, R.S. 1905. **Note on the germination of teak and other seeds**. Indian Forester 31(11): 635-638.

Experience of the author in seed germination of various species under various conditions in the Central Nursery Division are briefly noted.

1536 Pelmer, R.W.V. 1935. **Treatment of teak seed before sowing in taungyas**. Indian Forester 61(8): 526-513.

Reports on Burma experiments on teak seed germination. The successful method consists of soaking the seed for 12 hours and then spreading it out to dry for 48 hours, the operation repeated several times and then the seed is sown.

1537 Perera, W.R.H. 1973. **Seed for Sri-Lanka's reforestation programme**. IUFRO International Symposium, Bergen, Norway on Seed Problems, 4-14 September, Vol. II: 13p.

A brief account is given of the situation, topography, climate zones and the natural forests of Sri Lanka. An extensive reforestation programme of 16,000 acres per year includes teak planting of 10,000 ac. Comments are also made on seed availability, quality, grading and certification to improve seed germination. Teak seed improvement programmes in Sri Lanka started by author in 1961 are also mentioned.

1538 Phothisaro, C; Thiamthong, S. 1978. **Observations on teak seed germination practice**. (Thai). Proceedings of the 1978 National Forestry Conference, Bangkok: 1-7. Ministry of Agriculture and Cooperatives, Bangkok.

1539 Piedrahita, E. 1979. **Study on storage and seed germination of *Tectona grandis***. (Spanish). First Seminar on forest seed, Colombia, 1979: 14.7-14.10. Primer Curso Sobre Semillas Forestales, Colombia.

1540 Pongpangan, S. 1966. **Study on the germination of teak fruits exposed to different duration and illumination of artificial light**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The experiment show that long duration exposure was better than short duration and intensity of light should be at suitable level, not too much nor too little.

1541 Pousugg, R.C. 1966. **Seed and nursery investigations-1966. Germination of teak seed and seedling development in the nursery**. Report of Thai-Danish Teak Improvement Centre 1967: 13p.

Germination tests of 1965, showed removal of exocarp by white ants increased germination percent. In a field test, the above treatment is found to be effective in producing higher number of nursery plants of uniform quality.

1542 Prasad, R; Jalil, P. 1986. **Emptiness in teak fruits from different areas of Madhya Pradesh**. Journal of Tropical Forestry 2(3): 207-212.

Fruits were collected from stands in Madhya Pradesh and from seed orchards in Dehra Dun, Nepanagar, Jabalpur and Seoni and emptiness and germination percentage recorded. There was no difference in emptiness among fruits of different origins although there was wide variation in germination. Germination was generally higher in seeds from comparatively moist areas.

1543 Punde, A.B. 1906. **Germination of teak**. Indian Forester 32(8): p409.

The method consists of cutting into the ground a bed of 3.5' x 2.5'x 6' deep and after removing all loose earth, bed filled with cowdung mixed with water. Put good healthy seeds and water every alternate day for a fortnight, and after a week majority will germinate.

1544 Rajput, A; Tiwari, K.P. 2001. **Effect of alternate chilling/heating on germination of fresh teak (*Tectona grandis* Linn.f.) drupes, without scarification of felty mesocarp**. Seed Science and Technology 29(1): 57-64.

This paper deals with the effect of alternate chilling and heating treatment on teak fruit to overcome mechanical dormancy due to hard stony endocarp. The endocarp is the main hindrance in seed germination. Quick change in temperature resulted in splitting of the endocarp and facilitated the emergence of the radicle.

1545 Ramana Rao, P.V. 1924. **Notes on the germination of teak seed in the course of one month**. Indian Forester 50(5): 259-260.

Reports Kurpum experiments, in which one or two day old cattle dung mixed with water to form a thick solution to which a small quantity of lime was added, in which teak seed was allowed to soak in the mixture; after 24 hours soaking, seed sown in beds prepared and solution sprinkled over them. Seed covered with thin layer of manure and allowed to germinate. After one month nearly 80 percent of seed germinated.

1546 Ramirez, C; Salazar, R. 2000. **A practical and effective system for the scarification of *Tectona grandis* Linn.f. seeds in Panama**. (Spanish). II Simposio sobre avances en la produccion de semillas forestales en America Latina: Memorias, Santo Domingo, Republica Dominicana, 18-22 de octubre 1999: 169-170. Centro Agronomico Tropical de Investigacion y Ensenanza (CATIE); Turrialba; Costa Rica .

A scarification machine is briefly described. The seed germination rate of this machine was approximately 95 percent, compared to 40 percent with a traditional method.

1547 Ratanakoses, S. 1967. **Storing of teak seed**. Report of Thai-Danish Teak Improvement Centre: 11p.

Experiments on storing of teak fruits for one year show open storing results in loss of germination ability almost 50 percent, storing in sealed containers reduces this loss of germination percent, sun drying prior to sealed storing retained germination capacity.

1548 Ratanakoses, S. 1968. **Experiments on germination of teak - in the faculty of forestry, Kasetsart University**. (Thai). Proceedings of the first Silvicultural Seminar, Royal Forest Department, Ministry of Agriculture, Bangkok R-118: 120-139.

Summaries of various papers on experiments under taken in the faculty are presented.

1549 Royal College of Forestry, Sweden. 1974. **International symposium on seed processing, Bergen, Norway, 1973. I. Seed processing**. 239p. Royal College of Forestry, Stockholm, Sweden.

Out of twenty two papers three papers are on new techniques and progress in processes of extraction of forest seeds, X-ray radiography of teak seed and collecting, processing and storing tree seed for research use.

1550 Royal College of Forestry, Sweden. 1974. **International symposium on seed processing, Bergen, Norway 1973. II. Seed problems of developing countries**. International Union of Forest Research Organisations, Working Party S2.01.06: Seed problems. Royal College of Forestry, Stockholm, Sweden.

Out of thirty one papers following papers are on forest tree seeds. Exotic forest tree seed in Rhodesia; seed problems in Thailand; germination test on teak seeds from fertilized and unfertilized mother trees; seeds from V-4 clone at Mae Moh teak seed orchard, Lampang, Thailand; Problems of forestal seeds in Bolivia and other Latin American countries; seed problems as they affect forestry practice in Ghana; production forestry and role of seed management: A report on India; some problems and developments in forest tree seed research; scope of research on problems of tree seed in Bangladesh; seeds for provenance tests and afforestation in South America; problems of teak seed; seed for Sri Lanka's reforestation programme; present status and some problems of forest tree seeds in Korea and forest seed in Cuba.

1551 Rujakom, S. 1962. **Germination of teak seeds in sand supplemented with calcium carbonate**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Control gave 10.25 percent germination and with 0.125 percent Calcium carbonate gave 10.25 percent; 0.25 percent concentration gave 6.5 percent; with 0.5 percent concentration 5.75 percent germination and with 1.0 percent concentration the germination is 7.0 percent.

1552 Saengdech, T. 1964. **Comparison of the germination of teak seeds after soaking in sulphuric acid and oven-heated of various temperatures and periods**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Treated seed with sulphuric acid at 2.5, 5.0 and 10 percent concentrations, at temperature 40, 60, 80 degree C for 12, 24 and 48 hours were tested. The 10 percent concentration gave poor germination and oven-heated upto various temperatures differed significantly and oven heating for 24 hours best and 12 hours poorest.

1553 Sahai, K; Tandon, S. 1993 . **Studies on flowering and seed quality of some trees of *Tectona grandis* Linn.f.** Indian Journal of Forestry 16(2): 127-131.

Detailed observations are reported on flowering and seed quality of three 20-yr-old trees of the National Botanical Research Institute at Lucknow, Uttar Pradesh.

1554 Saini, B.C; Misra, K.K; Singh, R.V. 1999. **Effect of pre-sowing seed treatment on germination of teak (*Tectona grandis* Linn.f.) seeds in sand beds**. Indian Journal of Forestry 22(3): 245-247.

Seeds collected from Uttar Pradesh were pre-treated with water before sowing. The seeds alternately soaked in fresh water and dried in air 3 times at 24-h intervals started germinating 14 days after sowing. Maximum germination percentage of 60.5 got in hot water treatment.

1555 Sakcharoen, S. 1968. **Study on the number of teak seedlings obtained from difference in media germination**. (Thai). Student Thesis. Kasetsart University, Bangkok.

No effect of germinating medium was found and more the seed sown more seedlings were obtained.

1556 Sarowart, Ch. 1964. **Study on the size of teak stumps obtained from seeds of various sizes**. (Thai). Student Thesis. Kasetsart University, Bangkok.

By sowing various sizes of seeds, no correlation was obtained between seed size and the size of stump, the height of seedlings and survival percentages.

1557 Satyendramohan, S. 1915. **Germination of teak**. Indian Forester 41(1): 24-25.

Reported an observation with regard to the germination of teak seed in the Manipur forests, Central India. Teak seed soaked in a mixture of goat's dung and water in a pit in this method.

1558 Savinthoru, S. 1963. **Comparison on the germination of teak fruit between soaking in different concentration of sulphuric acid**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Teak seeds soaked in sulphuric acid in 5 percent and 20 percent concentration give good germination but not different from control and 10 and 15 percent concentration.

1559 Sharma, J.K; Mohanan, C. 1980. **Spermoplane microflora of stored seeds of *Tectona grandis*, *Bombax ceiba* and *Eucalyptus* spp. in relation to germinability**. Proceedings of the IUFRO Symposium on Forest Seed Storage, Ontario, Canada, 23-27 September 1980: 107-125.

Stored seeds of species including teak were harboured by a rich spermoplane microflora. *Aspergillus* was the most predominant genus in all the tree species. *Actinomycetes* and eight other fungal genera are reported for the first time on seeds.

1560 Sharma, J.K; Mohanan, C. 1997. **Seed microflora of teak and its effect on seed germination and seedling growth**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 113-117. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

The investigation was aimed at studying the micro organisms associated with stored seeds of *Tectona grandis* and their probable role in affecting germinability and seedling growth. These microorganisms are reported not only affect the quality of seed by causing deterioration, decay, acidity, heating, mustiness and toxin production but also the loss of germinability.

1561 Shintorn, S. 1963. **Comparison of teak seed germination by soaking in various concentration of sulphuric acid**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Results of seed germination by soaking in various concentration of sulphuric acid are presented.

1562 Shirley, G.S. 1927. **Notching of germinating teak seeds**. Indian Forester 53(6): p373.

Reports the Burma method known as Tharrawady or UPO Haling's method, used since 1922 gave about 90 percent stocking. Reports use of method for sal and recently with *Taraktogenos hurzii* and *Hydrocarpus* sp. but long extended period of germination over one year limits the use of this method.

1563 Singh, B. 1956. **Teak seed treatment with bacterial action**. Proceedings of the 9th Silvicultural Conference, Dehra Dun 1956. Part 1: 84-85.

Review the various treatments applied in the past and describes a new procedure successfully tried in the drier conditions of Central India.

1564 Singh, T. 1932. **Notes on germination technique in the Central Province**. Indian Forester 58: 704-712.

Described the dona system of teak seed germination and its advantages and firing of the forest area to be naturally regenerated with teak.

1565 Sirikul, W. 1992. **Constraints to seed ontogeny and seed production in Thailand: An overview**. ASEAN Canada Forest Tree Seed Centre Project 14: 12p. ASEAN Canada Forest Tree Seed Centre, Saraburi, Thailand.

This paper reviews the factors associated with constraints to seed ontogeny and seed production in the four important tree species including teak in Thailand. Principal difficulties examined are juvenility, clonal variation and genotype X environment interactions.

1566 Sivakumar, V; Parthiban, K.T; Singh, B.G; Gnanambal, V.S; Anandalakshmi, R; Geetha, S. 2002. **Variability in drupe characters and their relationship on seed germination in teak (*Tectona grandis* Linn.f.)**. Silvae Genetica 51(5/6): 232-237.

Germination trials were conducted of the seeds collected from thirty sources covering India, Bangladesh and Laos. The mesocarp weight and drupe; shell weight ratio were negatively correlated with germination percentage. A polynomial regression for prediction of germination percentage using drupe; shell weight ratio was established. Germination percentage was correlated with the percentage of two seeded drupes.

1567 Sono, P. 1978. **Teak seed situation of Lampang Divisional Forest Office in 1978**. (Thai). Proceedings of the 1978 National Forestry Conference, Bangkok, 6 November 1978. Royal Forest Department, Ministry of Agriculture and Cooperatives, Bangkok.

1568 Srimathi, R.A; Emmanuel, C.J.S.K. 1986. **Improved teak seeds - management and eco-**

nomics. Journal of Tropical Forestry 2(4): 261-266.

Results are tabulated of a survey of planting targets and seed requirements for 24 species including teak by state in the central, north, south and east regions of India. Teak seed requirements by state, sowing rates and costs of collection are also given.

1569 Suangtho, V. 1980. **Factors controlling teak (*Tectona grandis* Linn.f.) seed germination and their importance to Thailand**. M.Sc Thesis. Australia National University.

1570 Suangtho, V. 1992. **Study on teak seed germination effects of long-term storage methods**. Proceedings of the Seminar on 50 Anniversary of Huay-Tak Teak plantation, Bangkok, 5-8 August 1992.

Five storage treatment procedures were applied included normal storage by keeping teak seeds in jute sacks and stored under shed, sealed container in cold room, aerated bags in cold room, sealed container in seed storage room and aerated bags in seed storage room. The results showed that storing of seeds in sealed container in cold room was the best method in keeping teak seed for a long period.

1571 Sukwong, S. 1963. **Study on the teak seed germination by alternate soaking in hot-water and oven-heated**. (Thai). Student Thesis. Kasetsart University, Bangkok.

After soaking in water for 48 hours, oven-heated for 35-40 degree C for 48 hours alternately for 8, 6, 4 and 2 times and control. Germination percent is 7.25, 10, 4.25, 1.25 and 5 percent respectively.

1572 Sumantakul, V; Yingransiri, T. 1979. **Long term teak seed storage**. (Thai). Report on silviculture 1977-1978. Ministry of Agriculture and Cooperatives, Bangkok. Royal Forest Department, Silviculture Division.

1573 Supidhyaporn, W. 1962. **A comparison of teak seed germination by different mechanical processes**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The experiment shows that naked seed gave 38.4 percent and results are significantly different from seed cut opposite radicle gave 26.6 percent germination, broken seed gave 25.6 percent and fruit gave 19.8 percent germination.

1574 Suresh, K.K; Jambulingam, R; Sekar, I. 1998. **Effect of fruit size and sowing density on quality and recovery of stumps in *Tectona grandis* (Linn. F.)**. International Tree Crops Journal 9(3): 195-202.

This study aimed at finding the effect of grading teak fruits on stump quality and optimal sowing density for different sizes of fruits. There was a positive and significant correlation between fruit size and the number of stumps. There was no correlation of fruit size with seedling size or of fruit size with stump size.

1575 Thaninpong, S. 1963. **Study on teak seed germination by soaking in oven-heated treatment and soaking in cold-water**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Oven heated seeds in hot water at 50 degree C for different periods and soaked in cold water gave the following results: 4 hours oven heated and cold water for 4 hours gave 30.5 percent, 3 hours oven heated and cold water for 4 hours gave 28.5 percent, 2 hours oven heated and cold water for 4 hours gave 34.5 percent, 1 hour oven heated and cold water gave 32 percent and control not oven and cold water for 4 hours gave 33.5 percent.

1576 Tiwari, C.K; Sharma, S; Verma, R.K. 2004. **Effect of fungicide and plant growth hormones on germination of teak (*Tectona grandis*)**. Journal of Tropical Forest Science 16(1): 25-34.

The effect of fungicide and plant growth hormones on germination of teak seed was studied in a four-factorial experiment. Under fungicide application maximum seed germination was recorded in NAA at 25 ppm, with three hours soaking followed by GA, at 15 ppm, 5 hours and IAA 5 ppm, 5 hours. Relative cost/benefit ration of hormone application and economics of seed treatment with fungicide and hormones showed that NAA and IAA, 5 ppm with fungicide were the best treatment.

1577 Totey, N.G; Shadangi, D.K; Khatri, P.K. 1994. **Allelopathic effects of van-tulsi (*Hyptis suaviolens*) on germination and growth of teak (*Tectona grandis*) seedlings**. Indian Journal of Forestry 17(2): 137-141.

Incorporation of *Hyptis suaviolens* into the soil in laboratory and nursery experiments inhibited the germination of teak and also inhibited the height growth of teak seedlings.

1578 Troup, R.S. 1905. **Teak dibblings why are they a failure?** Indian Forester 31(10): 565-568.

Failures are attributed to selection on sites not adequately exposed to heat of sun, too late sowings and non-preparation of ground by burning leaf litter, hoeing soil etc., before sowing and covering seed slightly.

1579 Troup, R.S. 1907. **The sowing or dibbling of teak seed in Burma**. Indian Forester 33(4): 183-185.

Author is of the opinion that the taungya system is the only one on which we can place reliance. Burmese teak plantations thinning programmes also discussed.

1580 Tuggerse, M.S. 1925. **Some methods for securing germination of teak-seed**. Indian Forester 51(4): 163-170.

Discussed on pretreatment of teak seed, handling of transplants and planting methods and recommends using of weathered seed and sowing *in situ*, use of one to two months old transplants and to use one year old plants.

1581 Tuggerse, M.S. 1925. **Some methods for securing germination of teak-seed**. Indian Forester 51(5): 230-231.

It is the part of an earlier report published in Indian Forester 51(4), 1925: 163-170 on germination of teak seed.

1582 Tuggerse, M.S. 1925. **Some methods for securing germination of teak-seed**. Indian Forester 51(10): 533-534.

Comments on pit method of treatment and opines seed will rot in heavy rainfall areas and recommends over ground treatment.

1583 Tuggerse, M.S. 1926. **Germination of teak seed**. Indian Forester 52(1): 32-33.

Weathering treatment of teak seed in sun and storage in gunny bags or bundles of dry hay are discussed.

1584 Tuggerse, M.S. 1928. **Viability of weathered teak seed**. Indian Forester 54(10): p543.

Teak seed weathered, kept packed in dry light paddy hay, when sown gave only 2.5 percent germination within one week and the author concludes that bulk of the teak seed after weathering does not retain its viability for more than one year.

1585 Unnikrishnan, K; Rajeev, K.P. 1990. **On germination of Indian teak (*Tectona grandis* Linn.f.)**. Indian Forester 116(12): 992-993.

Teak fruits collected from plantation in Kerala were cleaned and mesocarp was removed after soaking in water. Again treated by soaking in IAA or GA3 and control seeds were soaked in distilled water. All treatments increased germination over that of the control.

1586 Vasquez, W; Gonzalez, A. 1997 . **Calibration of a portable humidity measurement device, qwik-test for seeds of *Gmelina arborea* and *Tectona grandis***. Boletin Mejoramiento Genetico y Semillas Forestales 17: 19-24.

1587 Vasquez, W; Salazar, R. 2000. **Germination protocol for *Tectona grandis* Linn.f. in the laboratory**. (Spanish). II Simposio sobre avances en la produccion de semillas forestales en America Latina: Memorias, Santo Domingo, Republica Dominicana, 18-22 de octubre 1999: 159-162. Centro Agronomico Tropical de Investigacion y Ensenanza (CATIE); Turrialba; Costa Rica .

Teak seeds from Costa Rica were subjected to five treatments. The highest germination rate of 60 percent was obtained after scarification followed by 24 h in water at a temperature of 32°C without light.

1588 Vijaya, T; Srivasuki, K.P; Sastry, P.S. 1996. **Role of gibberellic acid in teak seed germination and the effect of *Glomus macrocarpus* on growth and sodic soil tolerance**. Annals of Forestry 4(2): 211-212.

The seeds were soaked in GA3 for 6 h at room temperature before testing germination. Sodic soil tolerance was studied using seedlings produced from the GA3 seed treatment. The seedlings were planted in pots and some of the pots had *Glomus macrocarpus* mixed into the soil. It is found that the mycorrhiza treated seedlings were more tolerant of the sodic soil, surviving better and exhibiting significantly greater growth and chlorophyll content than the controls.

1589 Viswanath, S; Surendran, T; Chacko, K.C; Chand Basha, S. 1996. **Effect of fruit grading, pre-sowing treatments and media on germination and growth of *Tectona grandis* Linn.f**. Journal of Tropical Forestry 11: 98-102.

Teak fruits collected from plantations in Kerala falling in moist teak zone were size graded and after presowing treatments sown in vermiculite and sand media. Analysis of results revealed that there was a distinct advantage in using large sized fruits. Pretreatment of seeds by soaking in GA3 100ppm solution for 12 hours yielded the best results out of the 4 pretreatments tested with respect to germination characteristics biometric and biomass observations.

1590 Wasuvanich, P. 1992. **Teak seed for reforestation programme**. Proceedings of the Seminar on 50 Anniversary of Huay-Tak Teak plantation, Bangkok, 5-8 August 1992.

1591 Wataniyakul, T. 1966. **Study on the germination percent of teak seeds at-11c for various periods**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The treatments include storage for 3, 6, 9 and 12 days. It was concluded storage has no effect on germination percent and height growth.

1592 Watcharakitti, S. 1962. **Comparison of the germination of teak seeds soaked in Sulphuric acid of different concentrations**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Five treatments - control 1, 20, 30 and 40 percent concentration used indicated that 10 and 20 percent gave best germination.

1593 Wijesinghe, L.C.A. 1963. **An investigation of the relation between the quantity of seed sown and the out-turn of stumps in teak nursery work**. Ceylon Forester (n.s.) 6(1/2): 31-36.

Taking into consideration both nursery space and cost of seed, it is concluded that out of the rates tested 12 lb. is found the best.

1594 Wijesinghe, L.C.A. 1963. **Pre-sowing treatment trials on teak**. Ceylon Forester (n.s.) 6(1/2): 4-11.

Experiments with different periods of soaking showed that best germination was obtained from seed soaked for 48 hrs.

1595 Wimbush, A. 1927. **Notching of germinating teak seeds**. Indian Forester 53(2): 86-88.

Describes a mount Stewart method wherein teak seed dumped in teak plantation area during South West monsoon and germinating seeds from dump were notched at stakes where regular sowings failed and 70 percent of saplings in successful teak plantations are attributed to this method. Pricking out 6"x6" germinating seeds in the nursery beds is also suggested.

1596 Wind, R. 1921. **Seed research in general and a few remarks and investigations on the flowering, fruit and germination of teak**. Tectona 14: 16-76; p116; 379-427.

1597 Wood, P.J. 1966. **Teak germination**. Tanzania Silvicultural Research Note 1967.

The author describes an experiment on germination with six treatments, results of which are reported in 1970, after further trials.

1598 Wood, P.J. 1970. **The germination of teak seed**. Silviculture Research Institute, Lushoto 13.

Germination experiments on freshly collected teak seed include broadcast sowing under shade, three days water soaking and broadcast in shade, broadcast in sunlight, sowing in sunlight, after three days soaking, eight months stored seed sown in sunlight, but shaded after germination and stored seed sowing in sunlight and shaded. Results confirm effectiveness of soaking teak seed for three days sowing in sunlight.

1599 Xuezhi, S; Wenming, L. 1991. **Studies on pretreatments and techniques for quick germination of teak fruits**. Forest Research, China 4(6): 616-622. Institute of Tropical Forestry, Chinese Academy of Forestry.

1600 Yadav, J.P. 1992. **Pre-treatment of teak seed to enhance germination**. Indian Forester 118(4): 260-264.

Teak seeds were collected from a plantation at Kailashahar, N. Tripura were given various soaking treatments and alternate soaking and drying at 24-h and 48-h intervals. The most rapid germination occurred in the alternate soaking and drying treatments but the highest total germination was in the soaking treatment of six days. All treatments except soaking for 10 and 12 days and the alternate soaking/drying treatments increased germination over that in the control.

1601 Yap, S.K; Wong, S.M. 1983. **Seed biology of *Acacia mangium*, *Albizia falcataria*, *Eucalyptus* spp., *Gmelina arborea*, *Maesopsis eminii*, *Pinus caribaea* and *Tectona grandis***. Malaysian Forester 46(1): 26-45.

Seed morphology, collection methods, extraction and storage and results of germination tests are described for seven species including teak.

1602 Yingransiri, T. 1979. **Seed characteristics among teak provenances**. (Thai). Proceedings of the Forestry Conference, 1979, Bangkok: 59-64. Ministry of Agriculture and Cooperatives, Bangkok.

1603 Yingransiri, T; Sumantakul, V. 1977. **Teak seed collection project**. (Thai). Proceedings of the National Forestry Conference, Bangkok, 16 December 1976: 588-598. Royal Forest Department, Ministry of Agriculture and Cooperatives, Bangkok.

Go top

Nursery Practices

1604 **Effect of diameter of teak stump used on survival percentage and early height growth**. Indian Forester 70(3), 1944: 79-80.

In an experiment carried out in the Bori forests, teak stumps over 0.5 inch diameter showed a 15 percentage higher survival and over 100 percentage greater height growth than stumps of smaller diameter.

1605 **The effect of longitudinal splitting of teak stumps**. Forest Research India and Burma 1946-47, 1950: p53.

Plants raised from halved teak stumps did not differ significantly in height growth from plants raised from whole stumps. Quartered stumps produced a significant loss of height growth. There is doubt whether these initial differences disappear with increasing age.

1606 **Size of teak stumps and comparison with dona (leaf-cup) plants and split stumps**. Forest Research, India and Burma 1948/49, Part 2, 1952: 23p.

Dona plants are found to have higher survival rate and better height growth at 1 year than stumps of 0.7 inch diameter and less. Height growth of stumps of 0.8 inch diameter was better than that of dona plants and survival 81 percent compared with 91 percent for dona plants.

1607 **Teak comparison of good and malformed stumps**. Forest Research in India Part II 1954-55, 1955: p74.

Malformed stumps are as effective as good stumps.

1608 **Teak: Splitting of teak stumps**. Forest Research in India Part II 1954-55, 1955: p74.

No difference was observed between entire and halved stumps in Madras state and hence in times of scarcity halved stumps can be used.

1609 Ani, J.R; Gopikumar, K. 1993. **Effect of potting media on growth and vigour of tree seedlings in the nursery**. Myforest 29(2): 121-124.

The effects of five growing media were tested on the growth of *Artocarpus hirsutus* and *Tectona grandis* in the Kerala University College of Forestry nursery. There were no significant differences between growing media for teak with regard to seedling height, diameter and number of leaves respectively.

1610 Apichart Kaosa ard. 1982. **Storage technique of teak (*Tectona grandis* Linn.f.) planting stumps**. Tropical forests: Source of energy through optimisation and diversification: 327-333. P.B.L. Srivastava, et al, Eds. Penerbit Universiti Pertanian Malaysia; Serdang; Malaya .

Stump plants of teak can be stored for over five months in an underground store filled with fine dry sand. Stumps lifted in Thailand during the dormant season and stored until the planting season survived and grew better than stumps that were conventionally lifted at the time of planting, especially under unfavorable planting conditions. Storage procedures and their research background are described.

1611 Apichart Kaosa ard. 1986. **Teak, *Tectona grandis*, Linn. F. nursery techniques with special reference to Thailand**. Danida Forest Seed Centre, Denmark, Seed leaflet 4A: 42p.

1612 Apichart Kaosa ard; Visetsiri, K. 1980. **Nursery techniques of teak. I. Effects of sowing depth on teak seed germination and seedling production**. (Thai). Vanasarn 38(1/4): 136-148.

Seeds were sown at depths of 0, 1.5, 3.0 and 4.5 cm and intervals of 1.5 cm in nursery beds. Both germination and seedling production were reduced with increasing depth.

1613 Basden, S.C. 1960. **Notes on deficiency symptoms in forest nurseries (*Tectona grandis*)**. Papua New Guinea Agricultural Journal 13(2): 76-77.

1614 Bhatnagar, H.P. 1966. **Effect of light on growth and uptake of nutrients in some forest tree seedlings**. Indian Forester 92(2): 79-84.

Determined the optimum light requirements of recently germinated seedlings of different species including *Tectona grandis*. Seedlings were subjected to varying amounts of shade for 1 1/2 years at Dehra Dun. Results of height and dry-weight measurements indicated that teak had grown most with approximately 94 percent daylight.

1615 Bryndum, K. 1966. **Seed and nursery investigations-1965**. Proceedings of the Seminar on Forest Seed and Tree Imperial, Thailand, 1966: 25p.

The various experiments in progress at Teak Improvement Centre are described with special reference to storing of teak seed, sowings in nurseries.

1616 Bryndum, K. 1971. **Teak nursery practice**. Vanasarn 29(1): 9-14.

Summarizes the results of research in 1965-69 at the Thai/Danish Teak Improvement Centre on the storage of teak seed and its grading, pre-sowing treatment and sowing rate in nurseries, on the lining out and watering of stock, and on the lifting and storing of stump plants.

1617 Champion, H.G. 1934. **Stump experiments in Java**. Indian Forester 60(3): 228-229.

The experience in Java and Dehra Dun of growing teak with stumps is reviewed.

1618 Chaudhari, N.R. 1963. **Preliminary trials of pre-sprouted stump planting for artificial regeneration of teak**. Indian Forester 89(9): 638-640.

This method will be a great promise for areas where there is a shortage of labour and the usual course of planting stumps at the onset of rains clashes with various agricultural operations.

1619 Dasappa. 1990. **Nursery techniques in teak (*Tectona grandis* Linn.f.) for afforestation**. Myforest 26(1): 23-31.

A brief account of nursery practices for teak in India is given which include information on distribution, provenances, silvicultural characters, seeds, transplanting and grafting, application of growth regulators and fertilizers and plant protection.

1620 Eidmann, F.E. 1933. **Cuttings and stumps**. (Dutch; English). Tectona 26: 618-679.

1621 Emmanuel, C.J.S.K; Bagchi, S. 1984. **Stock-scion compatibility in teak**. Silvae Genetica 33(2/3): 53-56.

Scions from plus trees from Kerala, Tamil Nadu, Andhra Pradesh, Orissa and Karnataka were grafted onto rootstocks of the Tunacadavu provenance from Tamil Nadu and kept in a mist chamber for the first 30 days and then under natural conditions for a further 30 days.

1622 Fernando, S.N.U. 1965. **Teak in Ceylon nurseries**. Ceylon Forester 7(1/2): 57-59.

A summary of nursery practice, with data on stocking from sampling of nursery beds and notes on storage of stump plants and pre-treatment of seed.

1623 Forest Department, Andhra Pradesh. 1935. **Draft prescriptions for teak nurseries for the guidance of working plan officers**. Forest Department, Andhra Pradesh, Ledger File 3.

Suggestions are offered on selection of site, type of nursery, preparation of the site, formation of beds, size of nursery, seed collection, quantity of seed to be sown, sowing method, seed treatment, tending of unthinned and thinned beds, shading the beds, outturn, costs, planting out stumps and method of planting stumps in the form of a departmental note for circulation.

1624 Forest Department, Coorg. 1939. **Treatment of teak stumps with Siradix-A**. Forest Department, Coorg, Annual Research Report 1939.

Field and nursery experiments were tried and results are furnished for survival and height growth. The treatment results in healthy initial development.

1625 Forest Department, West Bengal. 1959. **Nursery and garden works: *Tectona grandis***. Report of Forest Administration, West Bengal 1954/55: 31-32.

Experiments show that teak seed by soaking in pits give the maximum benefit at the end of 2 weeks after which further soaking had an adverse effect. Alternate soaking and drying for periods of 48 hours repeated approximately 6 times is also found effective.

1626 Griffith, A.L. 1936. **A brass gauge for use in making teak stumps**. Indian Forester 62(6): 350-351.

A brass gauge to measure the correct size of stumps of 0.4 to 0.6" was designed is described and illustrated.

1627 Griffith, A.L. 1942. **Stump production in Madras teak nurseries**. Indian Forest Records (n.s.) Silviculture 4: 225-257.

Experiments show that in order to get the highest production of stumps of the best size with the most economical use of seed, 1/8-1/5 lb. of seed should be sown per sq. ft. of nursery bed and no pricking out of seedlings done. And also reports that it is not desirable to use large central nurseries for teak because repeated cropping caused serious falling off in stump production in a few years and serious attacks by cock chafer and white ants occurred in 2 of the 5 years of the long-term nursery experiments.

1628 Griffith, A.L. 1943. **Stump production in Madras teak nurseries**. Indian Forester 69: 31-32.

1629 Gyimah, A; Siaw, D.E.K.A; Cobbina, J. 2001. **Manual for production of teak seedlings (*Tectona grandis*)**. Forestry Research Institute of Ghana. FORIG.

1630 Homfray, C.K. 1937. **Nursery and plantation notes for Bengal**. Bengal Government Press, Alipore: 203p.

1631 Hussain, A.M.M; Somasundaram, T.R; Subramanian, K.N. 1976. **A recent advance in teak culture**. Indian Forester 102(8): 531-532.

Buds from selected clones of *Tectona grandis* were grown successfully in polythene containers in a glasshouse, with artificial cooling and mist spray.

1632 Insawadhi, S. 1963. **Comparison of growth of teak stumps with single and double tap roots**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The survival of single tap root is better and growth of double tap root is better.

1633 Jackson, J.K. 1974. **Nursery techniques in the savanna region of Nigeria**. Federal Department of Forest Research, Nigeria, Research Paper Savanna Series 32: 8p.

Reviews nursery techniques use in the region and compares the merits of the planting stock raised from stump plants and plants raised in polypots.

1634 Kapoor, S.K. 1992. **Growth rate of teak seedlings in nursery**. Indian Forester 118(4): 303-304.

Details are given of nursery practices of bed preparation, seed source, time of sowing, germination, irrigation, weeding and hoeing, fertilizer application, insect attack and seedling condition.

1635 Khanal, B.K. 1975. **Nursery techniques for raising teak in Nepal**. Forests Department, Nepal, Technical Note 1-75: 4p.

Outlines techniques for the collection, storage and pre-treatment of teak seeds.

1636 Khedkar, M.H. 1999. **Advantages of raising teak (*Tectona grandis*) plantations by using root trainer plants**. Indian Forester 125(2): 133-136.

The performance of root trainer plants and stumps as planting stock of teak was compared. The growth of the root trainer plants was better and faster than that of the stump plants, but survival was similar. The root trainer plants have a shorter nursery period than stump plants).

1637 Khedkar, M.H; Subramanian, K. 1996. **Introduction of root trainer nursery technology in forestry sector - Maharashtra**. Indian Forester 122(3): 199-211.

A Nursery Development Unit has been created to introduce the root trainer nursery technology. Planting stocks of teak were raised in root trainers of 150 cm3 block type. Details of the efforts in introducing the root trainer nursery technology to raise the planting stock of different species including teak are described.

1638 Khedkar, M.H; Subramanian, K. 1997. **Trials on raising teak (*Tectona grandis*) planting stock in root trainers**. Indian Forester 123(2): 95-99.

This paper describes a trial to raise teak planting stock in block root trainers at two nurseries in Maharashtra. The teak seedlings raised in root trainers had given better lateral root development than the normal stump stock and produced multiple tap roots. The root trainer plants were found sturdier, healthier and had a larger collar girth than stump origin plants.

1639 Krishnankutty, C.N; Chacko, K.C. 2000. **A new criterion for estimating plantable stumps available in teak (*Tectona grandis* Linn.f.) nursery beds**. Journal of Tropical Forestry 16(4): 34-37.

For estimating the number of plantable stumps available in teak nursery beds in Kerala, a new plantability criterion based on seedling height as a proxy to stump thickness was identified.

1640 Kuerkool, P. 1985. **Nursery production techniques in Thailand**. Proceedings, Workshop on Nursery and Plantation Practices in the ASEAN, Jakarta, Indonesia, 3-7 October 1983: 36-42; 59-60. New Zealand Forest Service, Wellington, New Zealand.

Nursery practices followed by the Royal Forest Department servicing the reforestation programme in Thailand are described. An annual production of teak stumps of the department is 5 million.

1641 Kushalappa, K.A. 1980. **Permanent teak nurseries**. Myforest 16(3): 185-186.

The establishment of permanent teak nurseries in Karnataka and methods for accomplishing this outlined.

1642 Latif, M.A. 1982. **Distribution of the size of teak seedlings in the nurseries of Chittagong Forest Division**. Bano Biggyan Patrika 11(1/2): 24-27.

Data are presented from 5 nurseries on the total number of seedlings per bed, mean diameter 3 cm above the root collar, mean height, and numbers of seedlings with minimum root collar diameter of 1 or 1.2 cm. Estimates were made from measurements in sample strips in 50 beds per nursery using regression equations to calculate the number of seedlings for each root collar diameter limit. The best numbers were obtained from a nursery which used better seeds and a larger spacing. Further investigation on the optimum size of teak stumps for planting is recommended, since large variations in performance are presently found 5 months after planting.

1643 Latif, M.A; Islam, M.N; Choudhury, J.H. 1983. **Effect of stump diameter of teak on post planting survival and subsequent growth of height and diameter**. Bano Biggyan Patrika 12(1/2): 17-21.

Stump plants of diameter 1.01-2.00 cm are found producing the best height and diameter growth and the best survival in Bangladesh.

1644 Lauridsen, E.B. 1973. **Teak planting stock survives and grows well after storage**. TIC Experiment 75: 12p. Teak Improvement Centre, Ngao.

The study carried out to see if survival and growth after storage differs from unstored stumps. Storing of seedlings can be done in plastic containers and stumps in sawdust. Growth of stored plants was found better.

1645 Mathur, V.P. 1956. **Transplanting teak in containers**. Proceedings of the 8th silviculture Conference, Dehra Dun, 1951, Part 2: 250-252.

A detailed account of the technique of transplanting teak seedlings in leaf cups is given.

1646 Matin, M.A; Banik, R.L. 1993. **Effect of polybag size on growth of some forest tree seedlings of Bangladesh**. Bangladesh Journal of Forest Science 22(1/2): 37-43.

Seedlings of species including teak were raised in different sizes of polybags and growth performance studied in the nursery and in the field. The results showed that the height and diameter growth of the plants increased with the increasing size of polybag.

1647 Mbakwe, H.N. 1977. **Effect of asulam, dalapon and 2,4-D on the morphology of three months old teak seedlings**. Forest Series, Nigeria, Research Paper 37: 12p.

The herbicides asulam, dalapon and 2,4-D were sprayed on 3-month-old teak seedlings to assess their phytotoxicity. Asulam and dalapon caused damage to the seedlings. The younger leaves were not affected. Recovery was slower after application of dalapon and growth was retarded as a result of the loss of foliage. 2,4-D killed the seedlings.

1648 Mehrotra, M.D; Dadwal, V.S. 1978. **Study of the effect of gibberellic acid, urea and Rallis Tracel on the growth of teak in the nursery. I. Enhancement of growth of seedlings to transplantable size in the same growing season - a veritable possibility**. Indian Forester 104(10): 706-713.

Gibberellic acid applied as a foliar spray in nurseries increased the growth of teak seedlings, but they became lanky and chlorotic, with very small leaves. These adverse effects were reversed when the GA treatment was followed by weekly sprayings with urea + Rallis Tracel.

1649 Murugesh, M; Srinivasan, V.M; Rai, R.S.V; Annamalai, R. 1997. **Studies on curtailing nursery period in teak (*Tectona grandis*)**. Journal of Tropical Forest Science 10(1): 66-72.

A study was carried out at the Forest College and Research Institute, Tamil Nadu, on the optimal age of container seedlings and stumps of teak for best field performance under irrigated conditions. The optimal

ages for container seedlings and stumps were found to be 3 and 7 months respectively.

1650 Na Lampoon, A. 1963. **Percentage of survival and growth of teak after storing the stumps for various periods**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Survival and growth of stumps after storing for 1, 2, 3, and 4 weeks were found out. It is found that growth of stumps after one and two weeks storage are better than control and three and four weeks storage.

1651 Neelay, V.R; Negi, K.S. 1983. **Effect of gibberellic acid and nutrients on the growth of teak in nursery. I - Poor performance of treated stumps in the field**. Indian Forester 109(3): 121-126.

Gibberellic acid, urea and Rallis tracel were applied as foliar sprays to seedlings growing in nursery beds in Madhya Pradesh. By the application of GA various phytotoxic effects such as chlorosis and reduction of leaf size were observed but these were alleviated by subsequent application of urea and Rallis tracel.

1652 Nwoboshi, L.C. 1976. **Size and physiological grades of some hardwood seedlings produced under different nursery spacings in Nigeria**. Forest Science 22(3): 301-306.

Teak seedlings planted at four spacings were graded after one year old according to their root-collar diameter. Teak seedlings of three root-collar diameter classes were planted out as stump plants. Survival and height growth at 6 months were found best with the smallest diameter stump plants which also showed more rapid root initiation and elongation in pot trials at 3 months after transplanting.

1653 Oever, H.Ten. 1908. **The setting out of stumps**. Tectona 1: 42-43.

1654 Ohene Coffie, F. 1999. **Cost of production of seedlings of forest tree species in a small-scale nursery**. Ghana Journal of Forestry 8: 37-42.

The cost of producing seedlings of different forest tree species including teak was determined in Ghana. Results of the study indicated that the unit cost of raising one potted seedling from a one-hectare nursery was C 139.40 for *Tectona grandis*.

1655 Rajkhowa, S. 1965. **Studies in mutual competition amongst forest seedlings. II**. Indian Forester 91(11): 767-777.

Discusses germination percentage and seedling survival of different species including teak at different seedbed spacings.

1656 Rao, P.S; Venkaiah, K; Murti, S.S.N; Sattar, S.A. 2001. **Root trainer vs. stump planting of teak -- a comparative study**. Indian Forester 127(11): 1289-1293.

An experiment was conducted to compare the performance based on survival, height and basal girth of root-trainer raised seedlings and stumps of teak at a research centre in Rajahmundry, Andhra Pradesh. Results showed that the root-trainer seedlings had obtained the highest height and girth at ground level and survival than the stumps.

1657 Reddy, C.V.K; Rao, A.L (et al). 1970. **A note on the nursery and plantation techniques**. Note of study tour in Maharashtra in Silvicultural Ledger file of Andhra Pradesh Forest Department 1971.

The large scale nursery and plantation techniques followed in Maharashtra are described from seed storage to stump pulling. It is recommended grading of teak seed, storage for one year, application of inorganic fertilizers and elimination of organic manures.

1658 Saju, P.U; Gopikumar, K; Asokan, P.K; Ani, J.R. 2000. **Effect of shade on seedling growth of *Grevillea robusta*, *Tectona grandis* and *Ailanthus triphysa* in the nursery**. Indian Forester 126(1): 57-61.

An investigation on the effect of shade on growth of polybag seedlings of species including *Tectona grandis* was carried out at College of Forestry, Vellanikkara, Kerala. Growth performance was better in full sunlight than in shade for *Tectona grandis* seedlings with height, diameter, leaf area, leaf size, root weight, shoot weight, leaf weight and chlorophyll content.

1659 Sardar, M.G; Subramanian, K. 1997. **Modern teak nursery management in Forest Development Corporation of Maharashtra Limited**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 38-42. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

The establishment of big central teak nursery by Forest Development Corporation of Maharashtra Ltd. has paved way for concentrated working, effective supervision, proper application of inputs such as fertilizer, and efficient management of pesticides. The cost per stump is found to be about 31 paise. The stump is currently sold at 50 to 62 paise. The current teak improvement works such as selection of seed production areas, plus trees, establishment of clonal seed orchards, tissue culture, etc. lead to genetical improvement of teak.

1660 Sharma, M.C; Bhandari, P.S; Mohmmad, G; Paroha, S; Chandra, K.K. 1997. **Effect of different soil mixtures on the production of quality seedlings of *Tectona grandis* in nursery**. Vaniki Sandesh 21(4): 3-7.

The effect of different soil mixtures was investigated on the development and quality of teak seedlings in the nursery at the State Forest Research Institute, Madhya Pradesh. Mixtures of soil/sand/farmyard manure in proportions of 1:1:1 gave good results for the loam soil with respect to shoot and root development and biomass production.

1661 Siddappa Kannur; Devar, K.V. 2003. **Influence of growing media on the seedling growth of teak**. Myforest 39(4): 323-327.

The paper presents the results of nursery experiment carried out at the silviculture nursery, Sirsi, Karnataka to determine suitable soil medium for production of quality plating stock from the teak stumps. Soil medium consisting of soil, sand and farm yard manure in a ratio of 1:1:2 found exhibited superior for growth and biomass attributes followed by medium consisting of equal proportions of soil, sand and farm yard manure.

1662 Singhal, R.M. 1949. **The dona technique of raising teak seedlings**. Indian Forester 75(11): 447-448.

Seedlings are transplanted when 8-10 days old into donas or leaf cups made from leaves of *Bassia latifolia, Butea frondosa* or *Diospyros tupru*. Each dona is approximately 5 inch in diameter and 7 inch deep and has a perforated bottom. Survival is better, especially during drought in the case of this technique.

1663 Siriwallop, K. 1966. **Effects of** gibberellic **acid at various levels on teak seedlings of various ages**. (Thai). Student Thesis. Kasetsart University, Bangkok.

It is observed that gibberellic acid spraying used with 3 week old seedlings effects both height and weight of seedlings but no effect on diameter.

1664 Somabutra, B. 1964. **Comparison of the growth of teak seedlings by using different concentrations of Gibberellic acid**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Out of five gibberellic acid treatments viz. 25,50,75,100 ppm and control, it was found that 100 and 50 ppm. is five times effective that of control and 75 and 25 ppm treatments are 4.0 and 2.9 times that of control.

1665 Subramanian, K; Gadbail, V.M; Rambabu, N; Jha, M. 1995. **Effects of culling on planting stock production in teak nursery**. Indian Forester 121(6): 465-468.

Culling experiments carried out at the Wada Nursery, Maharashtra, indicated that culling to remove seedlings showing poor growth, infection or infestation, or to reduce overcrowding, produces uniform and better quality planting stock.

1666 Sumantakul, V. 1971. **NPK fertilizers experiment in teak nursery**. Unpublished Report on TIC Experiment No. 54a.

Discussed the experiment on application of NPK fertilizer to teak nursery seedlings. It is indicated a positive reaction to fertilizer application.

1667 Tanukit, W. 1966. **Study on the effect of different covering media on teak seedling survival**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Sand covering gave the highest survival of 10.75 percent and height of 46.31 cm but smallest sized stumps of 0.77 cm. Rice shell covering gave the lowest survival but biggest stumps of 0-99 cm. It was suggested to use ash covering for moderate sized stumps and survival.

1668 TEAKNET. 1997. **Storage of teak stumps**. Teaknet Newsletter 6: 5-6.

A technique is described for storing teak stumps (planting stock) in sand in roofed over pits. Survival of stored stumps was better than that of fresh stumps. Height growth was reported better in stored than fresh stumps.

1669 Thanchai, P. 1965. **Effect of Gibberellic acid on the growth of one year old teak**. (Thai).

Student Thesis. Kasetsart University, Bangkok.

Treatment with 100, 75 and 50 ppm and control showed that 75 and 50 ppm treatments are not different from control, when one year height growth is considered.

1670 Totey, N.G; Bhowmik, A.K; Khatri, P.K; Chonhan, J.S; Kulkarni, R. 1986. **Growth of teak seedlings in nursery**. Indian Forester 112(9): 792-800.

Teak seeds were sown in a nursery at Jabalpur, Madhya Pradesh and treated with 150 or 300 kg/ha N, 75 or 150 kg/ha P and/or K or left untreated. Seedling growth in height and weight were measured.

1671 Tun, T. 2000. **Stored teak stump, simple technology but very reliable results can be achieved**. TEAKNET Newsletter 19: 5-6.

1672 Yadav, A.S; Khare, P.K; Mishra, G.P. 1982. **Growth performance of *Tectona grandis* Linn.f. seedlings in different pot culture media**. Indian Journal of Forestry 5(2): 86-89.

Seeds were wetted and dried alternately for 2 months before sowing in soil beds at Sagar Botanical Garden. After one month seedlings of equal height were transferred to 15 different media. Media were made by mixing black natural soil, sand and sawdust in different proportions. Seedlings were measured and found that growth was better in pure black soil than any other medium.

Go top

Vegetative Propagation and Tissue Culture

(See also 0510, 0660)

1673 **Progress report of the Forest Administration in Coorg for 1939-40**. Mysore Residency Press, Bangalore, 1941: 50p.

It is indicated that treatment with Seradix A promotes early root formation on teak stumps and the development of stumping.

1674 **Clonal forestry II: Conservation and application**. 240p. Springer Verlag, Berlin, 1993.

The underlying theory and recent results concerning the propagation and use of clones in research and in production forestry are discussed. A chapter on clonal forestry with tropical hardwoods which include the clonal forestry of *Tectona grandis* by Mascarenhas, A.F; Muralidharan, E.M is also included.

1675 Ansari, S.A; Ginwal, H.S; Kumar, P; Singh, S. 2001. **Ascorbic acid promotes adventitious rhizogenesis in teak (*Tectona grandis*)**. Indian Forester 127(5): 599-602.

A study was conducted to test the auxins of IAA, IBA and NAA and non-auxins of B-vitamins - thiamin and pyridoxine and C-vitamins - ascorbic acid and boric acid for adventitious rhizogenesis in leafy juvenile cuttings of teak.

1676 Ansari, S.A; Sharma, S; Pant, N.C; Mandal, A.K. 2002. **Synergism between IBA and thiamine for induction and growth of adventitious roots in *Tectona grandis***. Journal of Sustainable Forestry 15(4): 99-111.

Application of IBA and thiamine was investigated for induction and growth of adventitious roots in branch cuttings of teak. Administration of 1000 ppm IBA x 800 ppm thiamine is recommended for clonal propagation of teak on a large scale.

1677 Apavatjrut, P; Apichart Kaosa ard; Paratasilpin, T. 1988. **Current research on teak (*Tectona grandis* Linn.f.) tissue culture in Thailand**. Application of Tissue Culture Techniques economically important tropical trees. Biotrop Special Publication 35: 107-115.

1678 Apichart Kaosa ard. 1992. **Teak tissue culture**. Proceedings of the Seminar on 50 Anniversary of Huay-Tak Teak plantation, Bangkok, 5-8 August 1992.

1679 Apichart Kaosa ard; Apavatjrut, P. 1987. **Teak tissue culture**. Proceedings of His Majesty's 5th Cycle Commemorative Conference of USAID Science Research.

1680 Bahoenta, L; Sutjiati, L; Sumamburat, W. 1995. **Vegetative propagation of *Tectona grandis*: Culture technique**. Duta Rimba 20(181/182): 31-34.

1681 Bhatnagar, H.P. 1973. **Effect of hormone application on seasonal variation in rooting response of branch cuttings of forest trees**. Proceedings of Forestry Conference, 6-10 December 1973. Forest Research Institute, Dehra Dun.

1682 Bhatnagar, H.P; Joshi, D.N. 1978. **Rooting response of branch cuttings of teak (*Tectona grandis* Linn.f.)**. Indian Journal of Forestry 1(1): 79-83. [Proceedings of the Seventh World Forestry Congress, Centro Cultural General San Martin, Buenos Aires, Argentina, 4-18 October 1972, Vol. II, silviculture. 3. Trends and progress in new forest management and silvicultural techniques: 2045-2048].

Cuttings were taken from a 35-yr-old tree at Dehra Dun and dipped for 24 h in aqueous solutions of IAA, IBA or indolepropionic acid before setting in sand. Rooting and callus formation were recorded. All the hormone treatments are found promoted rooting and callus formation.

1683 Bhattacharya, A; Mandal, S. 1997. **Studies on in vivo pollen germination of some angiospermic plants**. Journal of Palynology 33(1/2): 153-156.

The paper deals with the in vivo germination of pollen grains of five angiospermic plants including *Tectona grandis*. Pollen germination was studied at different time intervals in the first day following anthesis. Highest *in vivo* pollen germination was recorded in *T. grandis*.

1684 Bingchao, K; Shuzhen, Z. 1991. **Standard of teak stump and its economic benefit**. Forest Research, China 4(6): 569-595. Institute, of Tropical Forestry, Chinese Academy of Forestry.

1685 Bon, M.C; Monteuuis, O. 1996. **Forest biotechnology in Sabah: Initial report**. Bois et Forests des Tropiques 248: 31-42.

An account is given of activities during the first two years of a joint project for forest biotechnology development and research, undertaken by CIRAD-Foret and Innoprise Corporation Sdn Bhd in Malaysia. Micropropagation techniques have been established for rattans and teak.

1686 Bonal, D; Monteuuis, O. 1997. **Ex vitro survival, rooting and initial development of in vitro rooted vs. unrooted microshoots from juvenile and mature *Tectona grandis* genotypes**. Silvae Genetica 46(5): 301-306.

The influence of in vitro formed adventitious roots on acclimatization and initial ex vitro development of microshoots from juvenile and mature teak genotypes was investigated. The in vitro rooted microshoots gave rise to higher survival.

1687 Britwum, S.P.K. 1970. **Vegetative propagation of some tropical forest trees**. Forest Product Research Institute, Technical Newsletter 4(1): 10-15.

1688 Bryndum, K. 1969. **Budding of teak**. Indian Forester 95(3): 155-157.

Describes the techniques followed at the Teak Improvement Centre, N. Thailand. Budding in November-December gives good results. Results are compared with those in India.

1689 Cao, Y.H; Wang, B.S. 1981. **Study on induction of rooting and survival of transplanted *Tectona grandis* Linn.f. in vitro**. Acta Botanica Sinica 23(6): 434-440.

The study reports on induction of rooting and survival rate of transplantation, after leafy shoots have been obtained in vitro. Out of three kinds of auxin ie. IAA, IBA, NAA were used for root induction, IBA was found the best.

1690 Chadhar, S.K; Sharma, M.C; Patley, R.K. 1998. **Suitable age of seedlings for preparing root shoots**. Vaniki Sandesh 22(1): 2-4.

Root-shoot cuttings were prepared from nursery seedlings of four species which include *Tectona grandis* in Madhya Pradesh. Seventeen month old seedlings gave the best results in terms of survival. Shoot growth was best in 13-month-old seedlings for *T. grandis*.

1691 Chamnankit, S. 1986. **Rooting variable of teak clone**. Research Report of Silviculture in 1984-1985, Royal Forestry Department, Bangkok 2: 381-389.

1692 Chia, F.R. 2003. **Field performance of tissue culture derived teak (*Tectona grandis*)**. Journal of Tropical Forest Science 15(3): 493-496.

This paper discusses the performance and characteristics of teak, clonally propagated through tissue culture in the nursery. Parameters measured were height, diameter at breast height, number of branches produced and number of trees producing flowers.

1693 Dabral, S.L. 1977. **Propagation of teak by root grafts**. Indian Forester 103(3): 225-230.

A new technique is described for propagating clones of *Tectona grandis*, which is difficult to root. Grafting a root from a seedling 1-2 years old on to the flowering

branch of a plus tree or grafted clone was shown to yield over 90 percent success.

1694 Dabral, S.N; Ghei, V.N. 1961. **Some further trials with gibberellic acid**. Indian Forester 87(10): 583-589.

Observations are made on seedlings treated with gibberellic acid after transplanting. The effects of gibberellic acid did not persist after the treatment has stopped, height growth slowed down and morphological differences disappeared, but poor root development continued.

1695 Daquinta, M; Ramos, L; Capote, I; Lezcano, Y; Rodriguez, R; Trina, D; Escalona, M. 2001. **Micropropagation of teak (*Tectona grandis* Linn.f.)**. (Spanish). Revista Forestal Centroamericana 35: 25-28.

Epicormic shoots from teak trees in a forest nursery in Cuba, planted in pots in zeolite under cover and irrigated with a micro-jet. The buds of the epicormic shoots were treated with the rooting hormones IBA and NAA. Shoots from juvenile plants grown from seed were treated in the same way. Further testing was done in vitro.

1696 Daquinta, M; Ramos, L; Capote, I; Lezcano, Y; Rodriguez, R; Escalona, M. 2002. **Calli induction and plant regeneration in *Tectona grandis* Linn.f.** Biotecnologia Vegetal 2(1): 15-19.

A study was conducted to investigate the calluses induction and plant regeneration by shoot tips, immature flowers of mature tree explants and cotyledons from seed of *Tectona grandis*.

1697 Daquinta, M; Ramos, L; Capote, I; Lezcano, Y; Rodriguez, R; Escalona, M. 2002. **Morphogenesis *in vitro* of teak (*Tectona grandis* Linn.f.)**. (Spanish). Investigacion Agraria, Sistemas y Recursos Forestales 11(1): 137-144.

1698 Daquinta, M; Ramos, L; Lezcano, Y; Rodriguez, R; Escalona, M. 2000. **Some elements in the micropropagation of teak**. (Spanish). Biotecnologia Vegetal 1: 39-44.

A methodology of producing propagules from young and mature explants of *Tectona grandis* via in vitro propagation is presented. Different cytokinins were tested for shoot proliferation and auxins for ex vitro rooting and a procedure was developed to micropropagate elite mature trees.

1699 Darmono, R. 1987. **The technique of storing teak stumps in Ngao, Lampang**. (Indonesian). Duta Rimba 13(89/90): 22-28.

The production, storage and use of teak stumps is described and discussed with particular reference to studies on teak propagation in Thailand, and the potential use of the method in Indonesia.

1700 Date, G.P; Jalil, P. 1985. **Effect of gibberellic acid, Rallis Tracel-1 and urea on the growth of teak seedlings**. Journal of Tropical Forestry 1(4): 341-349.

Two months old seedlings were treated with 200 or 300 p.p.m. gibberellic acid, 0.1 percent Rallis Tracel containing Zn, Fe, Mn, Mo, B, Mg and S and 0.25 percent urea. Treated plants are found to have longer shoots, but these were lanky with larger internodes and chlorotic leaves.

1701 Devi, Y.S; Mukherjee, B.B; Gupta, S. 1994. **Rapid cloning of elite teak (*Tectona grandis* Linn.f.) by in vitro multiple shoot production**. Indian Journal of Experimental Biology 32(9): 668-671.

Shoot buds of different sizes were collected from an elite tree of West Bengal and the buds were cultured in agar gelled medium for three successive passages to allow brown exudates to leach out. Buds were transferred to an establishment medium containing MS salts + 1 mg/litre kinetin and 1 mg/litre benzyladenine along with adenine sulfate. Apical shoots 5-9 mm long collected in December were best for establishing cultures.

1702 Dharncaai, P. 1965. **Effect of gibberellic acid on the growth of one year old teak**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Teak seed treated with gibberellic acid of 100 p.p.m. increased height growth.

1703 Fernandez, E.E. 1876. **On production of shoots by teak trees in Central Province: A question of root-suckers production**. Proceedings of Forestry Conference, Simla. Forest Research Institute, Dehra Dun.

1704 Forest Department, Andhra Pradesh. 1935. **Grafting of teak: A short note**. Forest Department, Andhra Pradesh and Madras Ledger File 4.

It is shown that cleft grafting and bud or eye grafting both suitable for teak.

1705 Gangopadhyay, G; Gangopadhyay, S.B; Poddar, R; Gupta, S; Mukherjee, K.K. 2003. **Micropropagation of *Tectona grandis*: Assessment of genetic fidelity**. Biologia Plantarum 46(3): 459-461.

Random amplified polymorphic DNA markers were used to analyze genetic fidelity of micropropagated teak clones with respect to subcultural passage. Of the twenty primers screened, no variation in RAPD profiles was noticed in the in vitro clones of fifth, tenth, fifteenth and twentieth passage in comparison to the in vivo mother plants.

1706 Gavinlertvatana, P. 1995. **Commercial micropropagation of teak in Thailand. Teak for the future**. Proceedings of the 2nd Regional Seminar on Teak, Yangon, Myanmar, 29 May-3 June 1995.

1707 Goh, D.K.S; Galiana, A. 2000. **Vegetative propagation of teak**. Proceedings of the Seminar on High Value Timber Species for Plantation Establishment - Teak and Mahoganies, Sabah, 1-2 December 1998. JIRCAS Working Report 16: 35-44. H.H. Chan; K. Matsumoto, Eds.

A summary of experience gained in developing vegetative propagation techniques for teak by ICSB (Innoprise Corporation Sdn. Bhd) and CIRAD-Foret in Sabah, Malaysia is presented. Protocols are outlined for tissue culture from micro-shoots and ex vitro acclimatization.

1708 Goh, D; Monteuuis, O. 2001. **Production of tissue cultured teak: The plant biotechnology laboratory experience**. Potential and Opportunities in Marketing and Trade of Plantation Teak, Challenge for the New Millenium. Proceedings of the 3rd Regional Seminar on Teak, Yogyakarta, Indonesia, 31 July-4 August 2000: 237-247.

1709 Goswami, H; Keng, C.L; Teo, C.K.H. 1999. **In vitro shoot multiplication of *Tectona grandis***. Journal of Bioscience 10(1): 47-54.

1710 Gupta, P.K; Nadgir, A.L; Mascarenhas, A.F; Jagannathan, V. 1980. **Tissue culture of forest trees: Clonal multiplication of *Tectona grandis* Linn.f. (teak) by tissue culture**. Plant Science Letters 17(3): 259-268.

Plantlets were obtained from shoots excised from seedling explants and terminal buds of 100-year-old trees with high-quality wood on a medium containing 6-benzylamine purine and kinetin.

1711 Haines, R.J; Martin, B.E. 1995. **Biotechnology and the sustainable production of tropical timber**. ITTO Pre Project Report PPR 42/97 (F): p168.

1712 Hardjono, D; Leokito, D. 1959. **Budding experiment on teak**. Communication of Forest Research Institute, Bogor 68: 29p.

The budding method is described and illustrated. Success was related to the age of the mother tree from which scions were taken with mean figures of 70 percent successful buddings from those 20-50 years old.

1713 Hedegart, T. 1967. **Budding technique**. Progress Report of Thai-Danish Teak Improvement Centre, Nago, Thailand 1966: 1-8.

Budding experiments in progress were described and the double flap method developed was illustrated.

1714 Hedegart, T. 1968. **Budded stumps**. Teak Improvement Centre, Ngao, Lampang: 5p.

The results of the various budding experiments and the percentage of the success of each method is reported. Pre-sprouting of budded stumps and storing in fresh sawdust seems to contribute to greater percentage of success.

1715 Hedegart, T. 1968. **Investigation on propagation of teak by cuttings-1967**. Paper of Teak Improvement Centre, Nago, Lampang: 6p.

The investigations undertaken to examine the possibility of propagating teak by cuttings and to test the influence of two rooting hormones, auxins for root formation indicates, sealing cut end with wax on top helps rooting.

1716 Hedegart, T; Wangtara, N; Yingransiri, T. 1974. **Budded/potted teak stock**. Vanasarn 32(4): 337-341.

The traditional method of establishing clone collections and clonal seed orchards of *Tectona grandis* in Thailand is by budding stump plants in the field. A technique for raising stock by budding one-year-old stump plants grown in pots in a greenhouse is described and illustrated.

1717 Husen, A; Pal, M. 2000. **Analytical studies on the effects of interaction with respect to position, season and auxin on adventitious root formation in stem cuttings of mature**

teak (*Tectona grandis* Linn.f.). Annals of Forestry 8(2): 253-261.

The effect of canopy position of branch, season and treatment with NAA on the rooting of shoot cuttings of trees growing in Dehra Dun, Uttar Pradesh is studied. Treatment with NAA promoted the percentage of callusing, rooting, sprouting, number of shoots and roots per cutting and root length.

1718 Husen, A; Pal, M. 2001. **Interactive effect of auxin and etiolation on adventitious root formation in cuttings of *Tectona grandis* Linn.f.** Indian Forester 127(5): 526-532.

The effects of stock plant etiolation and auxin on rooting behaviour of stem cuttings taken from one-year old seedling of teak were investigated. It was observed that except mean shoot diameter, etiolation significantly increased mean shoot length, internodal length, number of coppice shoot, leaves and nodes, and the total soluble sugar content of the shoots.

1719 Husen, A; Pal, M. 2003. **Effect of serial bud grafting and etiolation on rejuvenation and rooting cuttings of mature trees of *Tectona grandis* Linn.f.** Silvae Genetica 52(2): 84-88.

An experiment was conducted to study the effect of serial bud grafting and etiolation on rooting stem cuttings. Auxiliary buds taken from two clones of mature teak trees and grafted on root stocks of two year old seedlings and again serially grafted on two year old root stocks. Clones of the first graft exhibited stronger rejuvenation as indicated by more profuse rooting of the cuttings after second serial grafting.

1720 Husen, A; Pal, M. 2003. **Clonal propagation of teak (*Tectona grandis* Linn.f.): Effect of IBA application and adventitious root regeneration on vertically split cuttings**. Silvae Genetica 52(3/4): 173-175.

Rooting behaviour of vertically split mono-nodal softwood cuttings of teak treated with indole-3-butyric acid is studied and found that these cuttings can be successfully used to mass multiply the clonal planting stock more rapidly.

1721 Jadjuabsin, S. 1967. **Storing of bud wood-1966**. Report of Thai-Danish Teak Improvement Centre, Ngao: 6p.

Reports the experiments on storing bud wood from two trees below freezing point, low temperature of approximately 10 degree C and in moist sawdust at room temperature. Moist sawdust is practicable upto 7 days storage.

1722 Jadjuabsin, S; Hedegart, T. 1968. **Storing of bud wood-1967**. Progress Report of Thai-Danish: 7p. Teak Improvement Centre, Ngao.

Experiments confirm the last year's work that storage in moist sawdust is good for a long period.

1723 John, C.K; Nadgauda, R.S; Mascarenhas, A.F. 1997. **Teak**. Tissue Culture of Economic Plants including Genetic Engineering Techniques: 110-128. Centre for Science and Technology of the Non-Aligned and other Developing Countries, New Delhi and Commonwealth Science Council, London.

Details of the micropropagation techniques followed for teak are discussed. Its distribution, biology, provenances, diseases and insect pests, economic importance, propagation, etc are. also discussed.

1724 Kadambi, K; Dabral, S.N. 1954. **Air layering in forestry practice**. Indian Forester 80(11): 721-724.

Forty two tree species including teak were tried for vegetative propagation by air layering method only eight species are successful. The details of the method as practiced at New Forest is given.

1725 Katwal, R.P.S; Singhal, R.M; Gurumurthi, K. 2001. **Quality propagule production and tissue culture of trees - discussion note**. Brainstorming session for Future Strategies for Tree Tissue Culture, Department of Biotechnology, India, 27 August, 2001.

1726 Kedharnath, S; Venkatesh, C.S. 1963. **Grafting as an aid in the breeding of teak (*Tectona grandis* Linn.f.) and semal (*Salmalia malabarica*)**. Proceedings of the FAO World Consultation on Forest Genetics and Tree Improvement, Stockholm FAO/FORGEN 63/-5/6: 2p.

Both top grafting and forkert type budding have been tried and found feasible in teak. Heteroplastic and reciprocal top grafting of stems of teak is found successful.

1727 Keiding, H. 1960. **Budding and grafting of teak (*Tectona grandis*)**. FAO Teak Sub-Commission, New Delhi, 1960, FAO/TSC-60/3.3: 6p.

Describes successful experiments in bud-grafting of teak by the `forkert' method

commonly used on *Hevea brasiliensis*. Bark patches containing a bud are grafted on to the exposed cambium of 2 + 0 stock in leaf. The method is promising for the establishment of seed orchards from good phenotypes.

1728 Keiding, H. 1961. **Budding and grafting of teak (*Tectona grandis* Linn.f.)**. Natural History Bulletin of the Siam Society 20: 27-39.

1729 Keiding, H; Boonkird, S. 1960. **Vegetative propagation of teak**. Unasylva 14(4): 193-194.

Describes successful experiments in budding teak by a method extensively employed on *Hevea brasiliensis*. Approximately 200 successful bud-grafts were made.

1730 Kendurkar, S.V; Dhage, A.B; Kulkarni, V.M; Jana, M.M; Mascarenhas, A.F. 1997. **Teak propagation**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 165-167. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

A modified MS basal medium containing low levels of hormones was found effective for all stages of tissue culture process of teak. Proliferation of axillary bud break without an intervening callus stage of adventitious shoot formation was achieved. Field evaluation of tissue culture raised plants revealed good growth and occurrence of flowering and production of viable seeds within three and half years.

1731 Kendurkar, S.V; Nadgauda, R.S; Sara von Arnold. 1999. **Studies on cryopreservation of teak (*Tectona grandis*): A tropical hardwood tree**. International Tree Biotechnology Meeting, NCL, Pune, 17-19 November 1999.

1732 Khaosaat, A; Aphawatcharut, P; Sombun, K. 1986. **Study and analysis of research on teak tissue culture**. Research Report of Silviculture in 1984-1985, Royal Forestry Department, Bangkok No. 2: 558-590.

1733 Khatri, J.H; Kukadia, M.U; Singh, R.R. 2001. **Micropropagation of teak (*Tectona grandis* Linn.f.)**. Indian Journal of Forestry 24(3): 368-371.

Laboratory experiments were conducted to explore the possibilities of micropropagating teak under controlled environment. To study the morphogenic response of teak explants in culture, Murashige and Skoog's medium and Woody Plant Medium were used.

1734 Kushalkar, R; Sharon, M. 1996. **Direct and indirect somatic embryogenesis in teak (*Tectona grandis* Linn.f.)**. Current Science 71(9): 712-715.

Apical and axillary buds from three-yr-old *Tectona grandis* were used to initiate the in vitro cultures. Callus from apical buds formed globular and heart-shaped somatic embryos on Murashige and Skoog medium.

1735 Lahiri, A.K. 1974. **Preliminary study on rooting of green wood cutting of teak**. Indian Forester 100(9): 559-560.

A note on trials in West Bengal in which vigorous terminal shoots of approximately 30 cm long and 4 cm in diameter were selected as cuttings from 15-year-old *Tectona grandis* trees. One hundred cuttings were planted horizontally in the soil, 20 percent of these sprouted and after 180 days were examined for root formation.

1736 Lahiri, A.K. 1985. **A note on possibilities of mound layering of teak**. Indian Forester 111(10): 870-871.

Stumps with coppice shoots were covered with soil after ringing the base of each shoot. The mounds were irrigated and all shoots had rooted, producing 15.6 percent roots/shoot on average.

1737 Lin, D.D. 1989. **The storage technique for small stick shoots of teak**. (Japanese). Tropical Forestry 16: 45-53.

Storage of bundles of small shoots of teak in tanks of sand is described. Preparation of the storage material is described including irrigation, fertilizer application and harvesting.

1738 Macalpine, R.I. 1935. **Teak seedlings versus root and shoot cuttings**. Indian Forester 61(12): 777-780.

Experience and method as applied to teak is reported from Kaptai, Chittagong Hills tracts in Bengal. The problems of transplanting and season are discussed and silvicultural experiments on root and shoot cuttings are reported.

1739 Mahapatra, P. 1970. **Experiment of grafting on teak in Orissa**. Proceedings of Seminar-cum-Workshop on Genetic Improvement of Forest Tree Seeds in India, Forest Research Institute, Dehra Dun: 80-82.

Reports the selection programme and breeding of teak undertaken in Orissa state, where 16 plus trees selected are included in a germplasm bank. Reports the results of grafting work done. The cleft grafting of teak followed in Orissa is considered a success taken in the state, for the supply of genetically improved seed for large scale future plantations.

1740 Mahtolia, D.C; Pal, M. 1995. **Effect of leaf retention and auxin treatment on rooting response of teak (*Tectona grandis* Linn.f.) cuttings**. Annals of Forestry 3(2): 188-192.

A study was taken up to find out the effects of leaf retention and IBA application on the rooting response of teak. Percentage rooting, number of roots produced per cutting, average root length and the dispersion of roots from the base of cuttings were significantly enhanced in the leafy cuttings by IBA application.

1741 Marsden, E. 1916. **Reproduction of teak by root suckers**. Indian Forester 42(2): 43-50.

Instances of reproduction of teak by root suckers are described and illustrated. It is reported as a method of reproduction of teak in Wyanad. The nature and characteristics of occurrence of root suckers is described and considers them as stool shoots.

1742 Mascarenhas, A.F; Kendurkar, S.V; Khuspe, S.S. 1991. **Micropropagation of teak**. Micropropagation of Woody Plants: 247-262. M.R. Ahuja, Ed. Kluwer Academic Publishers, Netherlands.

1743 Mascarenhas, A.F; Khuspe, S.S; Nadgauda, R.S; Gupta, P.K; Khan, B.M. 1988. **Potential of cell culture in plantation forestry programs**. Genetic manipulation of woody plants: 391-412. Basic Life Sciences 44. B.M. Khan; J.W. Hanover; D.E. Keathley, Eds. Plenum Press, New York, USA.

Results are summarized of field evaluations in India of plantlets produced by tissue culture of material from mature trees of species including *Tectona grandis*. Economic and other benefits of these procedures are discussed. Teak parents were comparatively selected on height, absence of side branches and good wood quality.

1744 Mathur, V.P. 1926. **Teak reproduction through cuttings**. Indian Forester 52(1): p33.

Early June cuttings sprouted in 15 days. Cuttings of 2nd week of August did not sprout at all. The high percentage of failures is attributed to late propagation, as teak in the locality flushed by mid-May.

1745 Meniaud, J. 1930. **Propagation of teak in tropical Africa**. Proceedings of the 5th International Tropical Agricultural Conference: p1002.

It is reported that the plantations of teak in the colonies on the Gulf of Guinea are as feasible as those in Indo-China, provided the trees are planted on the most favourable site. In Togoland and the Cameroons, teak grows as rapidly as the most vigorous native trees which produce wood of comparable density.

1746 Meniaud, J. 1930. **Teak and its propagation in Tropical Africa**. Extract des state et comptes Reirdus de e' Association Colonies-Sciences 62/63: 14p.

Planting of teak on favourable sites in the colonies of Gulf of Guianea are feasible as those of Indo-China. In Togoland and Cameroons, teak grows as rapidly as most of the native species and produces wood of comparable density and industrial value.

1747 Mishra, K; Mishra, G.P. 1984. **Effect of gibberellic acid on *Tectona grandis* and *Dendrocalamus strictus* seedlings**. Journal of Tree Sciences 3(1/2): 20-26.

One-month-old seedlings were sprayed once with concentrations of gibberellic acid ranging from 0.1 to 100 p.p.m. Shoot and root lengths and dry weight were recorded from 2 to 36 month old. All the lower doses of GA3 promoted seedling growth compared with control plants, the optimum dose is found 10 p.p.m. for *T. grandis*.

1748 Mishra, K; Mishra, G.P. 1986. **Effect of indole acetic acid on growth and dry matter production of *Dendrocalamus strictus* Nees and *Tectona grandis* Linn.f. seedlings**. Journal of Tree Sciences 5(2): 118-121.

The application of IAA to 1-month-old seedlings increased the growth and dry weight of shoots and roots but the use of higher concentrations suppressed growth.

1749 Mishra, M; Pal, M. 1997. **Aspects in vegetative propagation of teak**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 168-170. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Various methods of vegetative propagation of teak which can be used for raising clonal seed orchard, clonal banks and clonal plantation are reviewed. Grafting and budding are generally used for raising seed orchards and clonal bank plantations. Rooting branch cuttings of juvenile and adult tree has the potential for mass multiplication of clonal material rapidly for raising seed orchards and clonal plantations.

1750 Monteuuis, O. 1995. **Recent advances in mass clonal propagation of teak**. Proceedings of the International Workshop of Bio-Refor, Kangar, Malaysia, 28 November-1 December 1994. W. Ratman; Z.Y. Ahmad; H.M.S. Amir; H.A. Darus; K.C. Khoo; K. Suzuki; S. Sakurai; K. Ishii, Eds. Bio-Refor Tokyo; FRIM, Kuala Lumpur.

1751 Monteuuis, O. 2000. **Propagating teak by cuttings and microcuttings**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 209-222. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

A review of the vegetative propagation of rooted cuttings produced from stock plants in the nursery and in-vitro issued microcuttings. Discussed the establishment of clonal seed orchards and advantages and disadvantages of bulk propagation and clonal propagation.

1752 Monteuuis, O; Bon, M.C; Goh, D.K.S. 1998. **Propagation of teak by *in vitro* culture**. Bois et Forests des Tropiques 255: 19-29.

Propagation of teak by in vitro culture were assessed from the point of view of developing a protocol or production of plant material for forestry in Sabah, Malaysia. Plants obtained in vitro could be further micropropagated. The prospects of in vitro culture for propagating selected teak genotypes compared to propagation by rooted cuttings are discussed.

1753 Monteuuis, O; Bon, M.C; Goh, D.K.S. 1998. **Teak propagation by in vitro culture**. Bois et Forests des Tropiques 256: 43-53.

An English translation of a paper published in the journal Bois et Forets des Tropiques 255.

1754 Monteuuis, O; Goh, D.K.S. 1999. **About the use of clones in teak**. Bois et Forests des Tropiques 261: 28-38.

An account is given of research conducted in Sabah, Malaysia into the mass propagation of teak clones using cuttings or microcuttings. Production of clones on their own roots can be used for the improvement of planting material. Clonal propagation techniques can be used for establishing clonal seed orchards.

1755 Monteuuis, O; Vallauri, D; Poupard, C; Hazard, L; Yousof, Y; Wahap, L.A; Garcia, C; Chauviere, M. 1995. **Mass clonal propagation of mature teak trees (*Tectona grandis*) by rooted cuttings**. (French). Bois et Forests des Tropiques 243: 25-39.

Prospects for mass clonal propagation of 5- to 15-year-old teak trees by rooted cuttings were assessed in Sabah, Malaysia. The first generation of clonal offspring from *in situ* mature trees were produced by various propagation techniques - grafting, mound layering and shoot cuttings.

1756 Mundt, T. 1997. **Vegetative propagation of teak (*Tectona grandis*) by cutting**. TEAKNET Newsletter 7: 3-4.

Details are given of a procedure developed in Myanmar by the Tree Improvement Division of the Forest Research Institute.

1757 Muralidharan, E.M. 1997. **Micropropagation of teak, rosewood and sandal**. KFRI Research Report 119: 20p. Kerala Forest Research Institute, Peechi.

In teak, shoot tip and axillary bud collected from seedlings and from mature trees were used to initiate shoot cultures. In teak, sprouting of shoot tip and axillary bud was found better in seedling than in mature trees. The effect of cytokinins on shoot multiplication was tested in mature tree cultures and higher levels of benzyl aminopurine and kinetin were found to favour shoot multiplication.

1758 Nadgauda, R.S; Kendurkar, S.V; Kulkarni, V.M; Jana, M.M; Mascarenhas, A.F. 1997. **Advances in micropropagation of teak in IUFRO symposium 1997**. Forest Tree Science and Nursery Technique, Raipur, India.

1759 Nadgauda, R.S; Kendurkar, S.V; Kulkarni, V.M; Jana, M.M. 2000. **Biotechnology for the improvement of teak (*Tectona grandis* Linn.f.)**. Potential and Opportunities in Marketing and Trade of Plantation Teak, Challenge for the New Millennium, Yogyakarta, Indonesia, 31 July-August 2000.

1760 Nadgauda, R.S; Kendurkar, S.V; Kulkarni, V.M. 2003. **Tissue culture for improved productivity of teak**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Tissue culture is used for improved productivity through clonal multiplication of the superior plants. This was the first report on teak tissue culture indicating the possibility of application of tissue culture to forestry. The micropropagation technology was further refined and was used for scaling up of production of plants using elite/plus trees of teak and field planted at different locations in India. The presentation include work carried on improvement and up scaled of the micropropagation technology and field planting of the tissue culture raised propagules of teak.

1761 Nanda, K.K; Purohit, A.N; Adarsh Bala. 1968. **Seasonal rooting response of stem cuttings of some forest tree species to auxins**. Indian Forester 94(2): 154-162.

Rooting response of stem cuttings of thirty five tree species including teak were studied with different auxins and seasons. The results show that plant species vary markedly in their ability to root, planting season has a pronounced effect on rooting of the cuttings and effectiveness of auxins on rooting of cuttings varies with the season.

1762 Narasimhan, R; Dhruva, B, et. al. 1970. **Tissue culture on some woody species**. Proceedings of the Indian Academy of Sciences 71B(5): 204-212.

Describes different methods of growing tissue cultures of woody species including *Tectona grandis*. Teak grow well at a lower temperature on Murashige and Skoog's medium containing 1.0 p.p.m. of glycine.

1763 Nautiyal, S; Rawat, M.S; Pankaj Khullar. 1994. **Macropropagation of teak (*Tectona grandis* Linn.f.)**. Indian Forester 120(2): 146-151.

A review with particular reference to India and including accounts of grafting, budding and rooting of shoot cuttings.

1764 Nautiyal, S; Singh, U; Gurumurti, K. 1991. **Rooting response of branch cuttings of teak (*Tectona grandis*) as influenced by season and growth hormones**. Indian Forester 117(4): 249-255.

Branch cuttings were collected from young trees raised from seedlings and cuttings and old trees raised from cuttings. Cuttings were treated by dipping into solutions of IAA, IBA, NAA and IBA + NAA for 24 h and then planted in a soil/sand mixture in pots. Data on rooting and callusing after 120 days are presented and analysed.

1765 Nautiyal, S; Singh, U; Gurumurti, K. 1992. **Rooting response of branch cuttings of teak (*Tectona grandis*) as influenced by growth hormones and position of the cutting on the crown**. Indian Forester 118(2): 112-121.

Branch cuttings were treated with IAA, IBA and IAA + IBA solutions by dipping the basal portions for 24 h, and then planted in pots in soil/sand. Hormone treatments promoted rooting, but the responses varied with tree origin and growth in terms of numbers, while IAA promoted root length growth but not root numbers.

1766 Newman, H.L. 1931. **Root and shoot cuttings of teak as compared with nursery transplants**. Indian Forester 57(10): 528-529.

The advantages of raising teak plantations with root and shoot cuttings rather than nursery transplants in respect of vigour and less damage from an accidental fire is demonstrated.

1767 Noerhadi, E; Wirjodarmodjo. 1980. **Vegetative propagation of *Tectona grandis* Linn.f. and *Pinus merkusii* Jungh. et de Vries using tissue culture**. (English; Indonesian). Duta Rimba 6(42): 11-15.

1768 Pal, M. 1980. **Vegetative propagation of teak by rooting stem cuttings**. The Secondary Forestry Conference, Vol. II: 145-148.

1769 Palanisamy, K; Ansari, S.A; Mandal, A.K. 1995. **Standardization of vegetative propagation technology of teak, sisoo, neem, karanj and bamboos**. Proceedings of the International Workshop on Forestry Research Methods, Dehra Dun: 18-19.

1770 Palanisamy, K; Gireesan, K; Hegde, M. 2003. **Clonal propagation technology for teak for production of improved planting stock**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute,

Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Clonal propagation technology for mature teak trees and quality seedlings has been standardized. Indole butyric acid was found to be the most effective auxin for adventitious rhizogenesis in teak. Cuttings from coppice shoots of mature trees rooted between 72-91 percent in different seasons, while the cuttings from 1-2 year old stumps gave 79-100 percent rooting throughout the year.

1771 Palanisamy, K; Subramanian, K. 2001. **Vegetative propagation of mature teak trees (*Tectona grandis* Linn.f.)**. Silvae Genetica 50(5/6): 188-191.

Clonal propagation technology for mature teak trees is achieved for the first time. Indole butyric acid (IBA) was found to be the most effective auxin tested. Cuttings from coppice shoots of mature trees rooted between 74 to 91 percent with a 2000 ppm IBA treatment, while the cuttings from 1 to 2 year-old root-stocks rooted between 79 to 100 percent with 1000ppm IBA applied at different times of the year.

1772 Paosujja, R. 1971. **Teak: Vegetative propagation**. Proceedings of the Second Forestry Conference, Royal Forest Department, Bangkok R.129: 214-221.

Progress and problems encountered during vegetative propagation work of teak in Thailand are presented.

1773 Pianhanurak, P; Piyapan, P. 1996. **A preliminary study of rejuvenation of teak by the budding technique**. ASEAN Forest Tree Seed Centre Project, Thailand: 7p.

Shoots from mature buds grafted on stumps were rooted along with shoots from seedlings. Rooting vigour of seedling shoots was found better than that of shoots from the grafted buds. The rooting percentages were similar. Rooting of cuttings from grafted mature buds can be used for orchard establishment.

1774 Rahman, A.H.M.M. 1977. **Vegetative propagation of few forest species**. Bano Biggyan Patrika 6(1): 51-57.

Various propagation trials of various species including teak were performed in Bangladesh in 1973-75. Bud grafts were found successful. The rooting response of stem cuttings was increased by treatment with IAA or IBA at 10 and 100 p.p.m.

1775 Ratanakoses, S; Bhyndum, K. 1968. **Budding technique**. Progress Report Thai-Danish Teak Improvement Centre: 7p.

Budding experiments by forket method using the four different methods are described.

1776 Rawat, M.S; Kedharnath, S. 1968. **Field grafting and budding in teak (*Tectona grandis* Linn.f.)**. Indian Forester 94(3): 259-262.

Budding and cleft grafts proved equally successful. Best results were obtained in April and May at Dehra Dun.

1777 Rawat, M.S; Lakshmikantham, D; Kedharnath, S. 1973. **Bud grafting and growth of the grafts in teak**. Forestry Conference (Silvicultural Conference), 6-10 December 1973. Forest Research Institute, Dehra Dun.

1778 Reddy, S.K; Nagaraju, S; Shrihari, P.V; Farooq, S.A. 1997. **Rapid in vitro propagation of teak (*Tectona grandis* Linn.f.)**. Indian Forester 123(8): 778-780.

Seeds were prepared from ripe fruits collected in Andhra Pradesh, washed, and soaked in GA3 at 10 mg/litre. There was 100 percent germination after sterilizing with $HgCl_2$ and cultured on (1) MS basal medium with 3 percent sucrose at pH 5.4 and (2) autoclaved vermiculite + 1/4 MS constituents, in a growth chamber under a light/dark regime.

1779 Rowntree, J.B. 1942. **Propagation of teak by stem and branch cuttings**. Indian Forester 68(7): 396-397.

12" long teak cuttings placed horizontally in soil at 6'x6' spacing, at a depth of 1.5" were planted in April 1940. The cuttings are 2/3 inch in diameter. In all 87 percent of cuttings struck root by their week of May. By December, the plants are 5.5 ft. in height and after two growing seasons average height was found 4'3". At the end of two years 63 percent survival was found and all grafts have a normal root system.

1780 Ryan, G.M. 1904. **Reproduction by root suckers**. Indian Forester 30(9): 450-458.

Lists the species which produce root suckers. Teak reproduction from root suckers in Thana district has been briefly described.

1781 Seth, S.K; Mathauda, G.S. 1959. **Preliminary trials with gibberellic acid**. Indian Forester 85(9): 528-532.

Results of two trials conducted at New Forest with the object of studying the effect of gibberellic acid on tree seedlings including *Tectona grandis* are described. The stronger solutions gave greater height growth. With weaker solutions the plants were quite healthy and possessed well developed root systems.

1782 Shanmugavelu, K.G. 1966. **Studies on the effects of plant growth regulators on the seedlings of some tree plant species**. South Indian Horticulture 38(1/4): 24-35.

Seedlings of twenty tree species including teak were subjected to spray, soaking and lanolin-paste treatments with IAA, IBA, NAA, Chlorophenoxy-acetic acid (CPA) and gibberellic acid at various concentrations. The effects of the treatments on shoot and root production are tabulated.

1783 Sharma, S; Rana, P.K; Mandal, A.K; Ansari, S.A. 2000. **Promotion of in vitro shoot multiplication by Vipul (Triacontanol) and adventitious rhizogenesis by rice bran extract in *Tectona grandis***. Journal of Plant Biology 27(3): 265-269.

An economical micropropagation procedure for producing clonal planting stock from mature teak trees has been developed by inclusion of Vipul along with BAP for in vitro shoot multiplication and alcoholic rice bran extract alone for in vitro adventitious rhizogenesis in MS liquid media.

1784 Sharma, V.K; Uniyal, D.P. 2003. **Delayed graft incompatibility in heteroplastic interspecific graft between *Tectona grandis* Linn.f. and *Tectona hamiltoniana* wall after three decade**. Silvae Genetica 52(1): 24-25.

Extremely delayed graft-incompatibility and mortality of interspecific heteroplastic grafts of *Tectona grandis* and *T. hamiltoniana* after three decades was reported. Possible causes of incompatibility are discussed.

1785 Singh, S.P. 1994. **Grafting of teak for clonal teak seed orchard**. Vaniki Sandesh 18(2): 13-19.

In Madhya Pradesh.

1786 Siril, E.A; Tiwari, S.K. 1999. **A method for the synchronization of rooting and hardening of micropropagated shoots of teak (*Tectona grandis* Linn.f.) under ex vitro conditions**. Journal of Tropical Forestry 15(3): 229-232.

A procedure for the ex vitro rooting of micropropagated shoots of *Tectona grandis* has been developed. In vitro shoots harvested after 10 subcultures were dipped into auxin for two minutes and maintained in mist chamber conditions. The protocol described thus combined both rooting and hardening of in vitro raised shoots.

1787 Sita, G.L; Swamy, B.V.R; Puri, S. 1998. **Application of biotechnology in forest trees - clonal multiplication of sandalwood, rosewood, eucalypts, teak and bamboos by tissue culture in India**. Tree improvement: Applied research and technology transfer: 233-248. Science Publishers, Enfield.

The paper examines problems in conventional tree improvement programmes and the role of tissue culture in forestry and presents case studies for successfully micropropagated trees in India including teakwood.

1788 Sumantakul, V; Yingransiri, T. 1979. **Bud grafting of *Tectona hamiltoniana* onto *Tectona grandis* stock**. (Thai). Report on Silviculture 1977-1978. Ministry of Agriculture and Cooperatives, Bangkok. Royal Forest Department, Silviculture Division.

1789 Swaminathan, C; Srinivasan, V.M. 1996. **Seedling invigoration through plant growth substances in teak (*Tectona grandis*)**. Journal of Tropical Forest Science 8(3): 310-316.

The influence was studied of plant growth substances as promoters of seedling growth in teak stumps of nursery seedlings in Tamil Nadu. The slurry treatment method was used and growth of seedlings was monitored.

1790 Tewari, D.N. 1992. **A practical guide on clonal propagation of teak**. Ecosystems Research and Development Bureau, Philippines: 37p.

1791 Thompson, G.W. 1906. **A curious teak coppice shoot**. Indian Forester 32(10): 503-504.

1792 Tiwari, S.K; Tiwari, K.P; Siril, E.A. 2002. **An improved micropropagation protocol for teak**. Plant Cell, Tissue and Organ Culture 71(1): 1-6.

1793 Umboh, I; Setiawan, I; Kamil, H; Yani, S. 1989. **Use of in vitro culture techniques for multiplication of tropical forest tree species**

in Indonesia. (French). Les apports recents de la biologie vegetale en regions tropicales. Colloque en hommage au Professeur G. Mangenot organise a Orsay du 16-18 Novembre 1988. Bulletin de la Societe Botanique de France, Actualites Botaniques 136(3/4): 179-184.

Rejuvenation of adult trees and a three-step bud culture are described for six species including *Tectona grandis*.

1794 Uniyal, D.P; Rawat, M.S. 1995. **Effect of temperature and relative humidity on grafting and budding of teak (*Tectona grandis* Linn.f.)**. Indian Forester 121(6): 510-513.

Cleft grafting and patch budding are highly successful methods for clonal propagation of teak. Cleft grafting is a less economical method than patch budding in terms of time, material and work. Percentage success can be increased by the use of the greenhouse or mist chamber.

1795 Vakshasya, R.K; Rawat, M.S. 1985. **Evaluation of budding and field planting periods for teak seed orchard establishment**. Indian Forester 111(5): 328-332.

Teak scions were budded onto 2-yr-old stumps which were then transplanted into polythene pots subsequently planted out in the seed orchard. Plants derived from budding in March and field-planted in July gave the best results.

1796 Wang, B.S; Cao, Y.H; Huang, L.S. 1980. **Stem tip culture of teak in vitro**. Acta Botanica Sinica 22(2): 200-201.

1797 Warren, W.D.M. 1935. **Seedlings versus root and shoot cuttings**. Indian Forester 61(7): 465-466.

Teak seedlings from root and shoot cuttings of June 1933 planting gave 11' height in December 1934 and entire transplants of July 1933 looked poor and miserable are only 3' in height, while at the end of 1st year nearly 6" high with 59 percent casualities and one year behind in growth than root and shoot cuttings.

1798 White, K.J; Gavinlertvatana, P. 1999. **Vegetative reproduction of teak: The future to increased productivity**. Regional Seminar on Site, Technology and Productivity of Teak Plantations, Chiang Mai, Thailand, 26-29 January 1999.

1799 Winit-Rakchat. 1978. **Comparison of growth performance of stored and freshly prepared teak stumps**. (Thai). Proceedings of the 1978 National Forestry Conference, Thailand, 6 Nov 1978: 44-49. Ministry of Agriculture and Cooperatives, Bangkok.

1800 Yasodha, R; Sumathi, R; Gurumurthi, K. 1998. **Commercial micropropagation of teak**. Proceedings of Industrial-cum-Demonstration Workshop on Clonal Forestry, Coimbatore: 84-86. K. Subramanian; K. Gurumurthi; R.S.C. Jayaraj; K.C.S. Warrier, Eds.

1801 Yasodha, R; Sumathi, R; Gurumurthi, K. 2003. **Tissue culture strategies for quality planting stock production of teak**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

A total of 800 ha. of clonal seed orchard is established which can provide 15-16 million seedlings of good planting stock. Micropropagation technique was established to quantitatively enhance production of genetically improved planting stock using the seeds of clonal seed orchards. Comprehensive method for good shoot multiplication, cost effective rooting and application to a wide range of genotypes was developed. Seedlings raised from seeds collected from different clones in clonal seed orchard were used for culture establishment. Effects of cytokinins, solidifying agents, method of subculturing on shoot proliferation of teak were also discussed.

1802 Zope, J.S; Mukewar, A.M; Marawar, S.S. 1997. **Different techniques of vegetative propagation in teak**. PKV Research Journal 21(2): 206-207. Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola.

Four methods were tested for vegetative propagation of teak: air layering of coppice shoots, trench mounding, cleft grafting and shoot cuttings. Callus formation, sprouting, rooting and survival were recorded for each technique. Callus formation occurred in all methods, but only after IBA treatment.

Go top

Plantation Establishment

(See also 1590, 3796)

1803 **Cultivation of teak in Java**. Indian Forester 27, 1891: p448.

Contains province-wise figures of natural and plantation teak of Java.

1804 **Cultivation of teak in Dutch Netherlands**. Indian Forester 23(6), 1897: 195-201.

A translation describing teak forest of Java and cultivation method of teak under plantation contracts by local cultivators.

1805 **The cultivation of teak in Java**. Tectona 7, 1914: 190-192.

1806 **Respective merits of transplanting or direct sowing of teak in Puri, Orissa**. Indian Forester 46(2), 1920: 87-88.

Advantage of planting in lines is also discussed.

1807 **Stump planting of teak in dry localities**. Indian Forester 66, 1940: 682-683.

A discussion on Laurie (1940) original article on premonsoon stump planting of teak.

1808 **Annual report on silvicultural research in the Madras Presidency for the year 1940-41**. Superintendent, Government Press, Madras, 1942: 146p.

Experiments in the stump planting of teak show that early stump planting is advantageous and that planting the stumps with the top of the 1-inch shoot flush with the ground is beneficial both as regards survival and height growth.

1809 **Teak. The most valuable Asiatic tree species can easily be cultivated in Argentina**. (Spanish). Mundo maderero 5(61), 1945: 7-8.

Trials with teak in Argentina have indicated that it can easily be acclimatized to conditions in that country and it seems that its cultivation may be possible on a commercial scale. Brief notes are given on the preparation of the seed, nursery technique, sowing, spacing and time of planting.

1810 **Discussion on teak plantation establishment**. 2nd Regional Seminar on Teak, Yangon, Myanmar, 1995.

1811 Aimufia, D.I. 1972. **Report on Oria teak plantation**. Bulletin of the Nigerian Forestry Departments 32(2): 10-17.

Briefly describes the present condition of the small stand of *Tectona grandis* established at Oria in southern Nigeria in approximately 1911 and concludes that the plantation contains good-quality teak.

1812 Alphen de Veer, E.J van. 1956. **Teak cultivation in Java**. Proceedings of the 4th World Forest Congress, Dehra Dun, 1954: 322-328.

Describes and discusses the taungya method of establishment and underplanting with *Leucaena glauca*, which are the standard practice in Java and gives the yield table.

1813 Altona, T. 1927. **Age of the teak forests in the North-Eastern part of the residency of Madioen**. (Indonesian; English). Tectona 20: 1-16.

It is considered that the teak forests must have been developed in the region during the last 600 years. Mixed forests must have originated from abandoned local agriculture and present teak forests planted for economic use and to meet local requirements.

1814 Amoyaw, M.A. 1974. **Species trials on the Accra Plains and the establishment of Kpong Research Centre**. Forest Products Research Institute, Ghana, Technical Newsletter 8(1/2): 17-19.

The Kpong Research Centre was set up in 1955 to determine which tree species could be grown on the black cotton soils of the Accra Plains, and to develop suitable methods of planting and tending these trees. Numerous exotic and indigenous species including *Tectona grandis* were planted on the 21.8 ha area, prepared by burning, the removal of stumps and disc-ploughing.

1815 Aniwat Thunyathorn. 1989. **Estimating land suitability for *Pinus khasya* and *Tectona grandis* reforestations of Mae Chaem watershed in Changwat Chiang Mai (Thailand)**. Kasetsart university, Bangkok: 128 leaves.

Result of growth factor analysis showed that 13 percent of the total watershed area of 4,107 sq.km. was found suitable for *Tectona grandis*.

1816 Apichart Kaosa ard. 1995. **Overview problem in teak plantation establishment**. 2nd Regional Seminar on Teak, Yangon, Myanmar.

1817 Arce-Brenes, H; Arroyo-Castillo, E. 1981. **Establishment of permanent plots planted in common teak and Malay bushbeech**

(*Gmelina arborea*) **in Cabuya Monctezuma, Puntarenas**. (Spanish). Instituto Tecnologico de Costa Rica, Cartago, Costa Rica: 82p.

1818 Asiddao, F. 1959. **Progress report on sample plots**. Fillipino Forester 11: 69-77.

By 1959, 334 permanent sample plots had been established in the Philippines since the war. Their location, date of establishment and the number of measurements taken are tabulated. Results of some preliminary analyses of post-war data are given.

1819 Bajdalina, N.A. 1964. **First experience of organising work on forest physiology in the Democratic Republic of Vietnam**. (Russian). Problemy Exologii Fiziologii Lesynh Rastenij 2: 37-60.

Describes the setting up of an organization for the study of tree physiology in N. Vietnam with Russian assistance. Teak is one of the species studied. Measurements are tabulated of the daily and seasonal variations in transpiration, photosynthesis and respiration of several indigenous and exotic species. Relationship of photosynthesis to light and seasonal variation of chlorophyll content was studied for these species including teak.

1820 Ballantyne, J (et al). 1875. **Transplanting versus direct sowing of teak in India**. Indian Forester 1: 191-196; 413-414.

In the case of large and strong plants, cutting of tap-root is required before transplanting. When the plants are small and weak and ground light and dry, less interference with tap-root is better, transplanting experiments with teak in several localities and authors' experience in this regard are given.

1821 Barrance, A.J. 1988. **The potential of *Tectona grandis* (teak) in Vanuatu**. Forest Research Report, Vanuatu 1/88: 9p.

Experience with teak in Vanuatu is described. Silvicultural characteristics and requirements, pests and diseases, susceptibility to cyclone damage and utilization are discussed. The species appears to be of considerable potential and the establishment of large-scale provenance trials is recommended.

1822 Becking, J.H. 1928. **The growing of teak in Java**. Korte Meded Van het Boschhouw Proefsta 22; Forest Research Station Report 22.

1823 Becking, J.H. 1932. **The present position and future outlook on teak cultivation**. (Dutch). Tectona 25: 873-912.

1824 Beekman, H.A.J.M; Wechel, A Te. 1930. **Notes on teak (*Tectona grandis*) cultivation systems**. (Indonesian; English). Tectona 23: 149-165.

1825 Beyse, R. 1991. **Successful establishment of a teak plantation in Brazil**. (German). Forst und Holz 46(20): 563-564.

Successful establishment of fast-growing plantations of teak by a German-owned sawmilling company at Caceres, Mato Grosso, Brazil is described. The rotation is 25 years and yield is 320-330 m3/ha.

1826 Bhola, M.P. 1939. **Teak planting in Gorakhpur**. Indian Forester 55(10): 562-563.

Local seed as good as imported Burma seed, while Jhansi seed is poorest in germination and development of seedlings; (1) thus local seed of original Burma origin over 50 years has acclimatised; (2) temporary nurseries in planting site are preferred; and (3) teak cuttings planted in simple holes of 9-12 in. are good and gave satisfactory results.

1827 Bhuijan, A.A. 1979. **Afforestation of unclassed state forests lands areas in Chittagong Hill Tracts of Bangladesh**. Bano Biggyan Patrika 8(1/2): 64-70.

This paper discusses factors to be considered in formulating a compensatory afforestation programme for the infertile and denuded Hill Tracts. Factors discussed are choice of species, nursery practice, plantation establishment, use of fertilizers, pest control, labour supply and the importance of good forest road networks.

1828 Bos, J.H. 1934. **Remarks on the replanting of unsuccessful teak plantations in Padangan forest**. (Dutch; English). Tectona 27: 441-443 .

1829 Brandis, D. 1880. **On teak planting in Bombay**. Indian Forester 5: 307-310.

Reports on teak planting along the Kalinandi river. Suggests growing mixed forests and leaving unfelled jungle strips in between. Problems of raising, management and fire protection are discussed.

1830 Brascamp, E.H.B. 1910. **A trial cultivation**. Tectona 2: 172-174.

1831 Brascamp, E.H.B. 1916. **Have they tried to plant teak in South France etc?** (Indonesian; English). Tectona 9: 413-415.

1832 Brascamp, E.H.B. 1916. **How people in 1860 cultivated teak plantations**. Tectona 9: 481-484.

1833 Brascamp, E.H.B. 1921. **Memories of Governor of Ceylon Mr. W.J. van e Graaf and J.G. van Angelbeek in 1794 about teak cultivation, in Kolonial Archief No. XXV**. Tectona 14(2): 929-931.

1834 Budowski, G. 1960. **Reforestation of areas not suitable for Cacao**. (Spanish; English). Proceedings of 8th Inter-American Cacao Conference, Trinidad and Tobago: 428-435.

Tectona grandis is one of the species suggested for reforestation of steep and low fertility sites.

1835 Burman, W. 1883. **Teak cultivation**. Agriculture University, Wageningen.

1836 Burman, W. 1892. **Teak cultivation in Java**. Indian Forester 18: 285-292.

Describes the artificial cultivation methods followed for teak in Java.

1837 Butt, R.A. 1962. **Trials of species for timber planting in the savanna woodland zone of North Uganda**. British Commonwealth Forestry Conference, East Africa: 32p. Government Printer, Entebbe.

Describes some of the trials that are being made in Northern Uganda to replace uneconomic Terminalia/Combretum woodland with timber species most promising of these is teak.

1838 Chable, A.C. 1967. **Reforestation in the Republic of Honduras, Central America**. Ceiba, Tegucigalpa 13(2): 1-56.

Seed collection, propagation, planting, spacing, tending, soils and drainage, pests and diseases etc. are of different species including *Tectona grandis* are briefly discussed.

1839 Chaplin, G.E; Neumann, A.J. 1987. **Afforestation on the Guadalcanal grasslands**. Forest Division, Solomon Islands, Forestry Note 18-2-87: 17p.

The potential benefits and problems of afforestation on these grasslands at Honiara, Solomon Islands are considered. Basic information on the site relevance to afforestation is given and possible objectives of a programme, existing trials and expected growth rates reviewed. Silvicultural recommendations are made, including the suggestion of *Tectona grandis* as the most appropriate species with smaller scale planting of *Samanea saman*.

1840 Chollet, A. 1952. **Report on Togo**. (French). Proceedings of the 1st Conference of Forestry Inter African Countries, Abidjan, 1951: 269-282.

Covers policy, fires and cultivation of teak; reforestation in the savanna is also included.

1841 Classen, J.C van R. 1916. **Working plan of cultivation of teak by coolies in the Nagawi forest section etc**. (Indonesian; English). Tectona 9: 181-195.

1842 Cooling, E.N.C; Endean, F. 1967. **Preliminary results from trials of exotic species from Zambian plantations**. Forest Research Bulletin, Forest Department Zambia 10.

1843 Copleston, W.E. 1914. **Cultivation of natural teak seedlings in the Haliyal teak pole forests worked on coppice with standards system**. Indian Forester 40(9): 461-463.

Describes the method of experimental cultivation of natural seedlings occurring plentifully in forest in the rainy season to make them survive summer-drought in Dharwar area.

1844 Corner, E.J.H. 1952. **Wayside trees of Malaya**. Government Printing Office, Singapore 1: 705-706.

Describes *Tectona grandis* introduced from Burma, giving a general description of tree and growth conditions in Malaya.

1845 Dacanay, P. 1946. **Progress of reforestation in the Philippines**. Rev. Int. Prod. colon. 196-197: 10-15.

An account is given of forest legislation in the Philippines and of the various reforestation projects undertaken by the Bureau of Forestry either for conservation purposes or to provide firewood. Certain important species including *Tectona grandis* has been found successful for reforestation.

1846 Danaatmadja, O. 1991. **Establishment of industrial plantation forests by Perum Perhutani in East Nusa Tenggara Province: A view of the establishment in Kupang region**. Duta Rimba 17(135/136): 2-7 (In); 8-11 (En).

The main species planted include teak.

1847 Deventer, A.J van. 1910. **Cultivation with respect to profits and regulations of operations**. (Dutch; English). Tectona 2(1): p328.

1848 Divekar, M.V. 1933. **Early stump planting of teak in Kanara North Division**. Indian Forester 59(9): 584-588.

Reports results of an experimental trial of early stump planting of teak and quotes good results obtained in moist areas of North Division Kanara and teak pole area of Haliyal range which is comparatively a drier area.

1849 Drees, E.M. 1954. **Silvicultural problems in dry monsoon areas in Indonesia**. Tectona 43(1/2): 111-118.

Dry monsoon areas are defined as those lowland regions that are unsuitable for teak plantations, owing to deficiency or unfavourable distribution of rainfall. Possibilities of afforestation are discussed.

1850 Dupuy, B. 1991. **Afforestation and reforestation**. World Forestry Congress, Paris, September 17-26, 1991.

1851 Eckert. 1905. **Cultivation of teak in Tanganyika**. Forestry in German East Africa 2: 285p.

1852 FAO. 1874. **Guide for the planting and cultivation of teak trees in Government forests in Java and Madura**. Official Gazette 214, 1874. FAO/TSC, Bangkok, 1956.

Reference to bibliography on teak: Country report Indonesia in 1st session of FAO/TSC Bangkok, 1956.

1853 FAO. 1968. **Man-made forests: Establishment methods and techniques**. FAO world symposium on man-made forests and their industrial importance. FAO, Rome.

A paper on teak planting in Tanzania is also included.

1854 Feungchan, S; Bunpromma, K; Srinukool, S; Rungsimanop, C. 1996. **Preliminary study on cultivation of commercial timbers**. Khon Kaen Agriculture Journal 24(3): 132-134.

Information on the cultivation of commercial timbers including *Tectona grandis* is included.

1855 Firdaus, A.Ch. 1979. **Trial of teak forest cultivation**. (Indonesian). Gema Rimba 5(39-40): 57-60.

1856 Forest Department, Kenya. 1940. **Stump planting**. Research Bulletin, Forest Department, Kenya 1: 3p.

Results of the experiments to discover with what degree of success over nursery stock in Kenya stumped and planted out are presented. In the moist climate of Kakamega, transplants and stumps of Burma teak both grew well, but the latter are found much simpler to raise in the nursery.

1857 Forest Department, Nigeria. 1947. **Fuel plantations in Nigeria**. Report Forest Administration, Nigeria 1945-46: 14p .

Teak is the most successful fuel and pole crop on good soils where there is an adequate rainfall.

1858 Forest Department, Nigeria. 1964. **The role of forestry in the economic development of the savanna areas of Nigeria**. Proceedings of the 1st Nigerian Forestry Conference, Kaduna, 1964: p189.

A conversion system for the management of coppiced teak plantations is discussed.

1859 Forest Department, West Bengal. 1955. **Bamanpokri teak plantations, Kurseong Division**. Forest Department, West Bengal: 10p.

Gives an account of the establishment, performance, growth data etc., of mixed plantations of teak with sal and other species, established 1868-88, and of a new series started in 1941.

1860 Forest Department, Zanzibar. 1952. **Afforestation of Semi-wanda areas**. Report of Department of Agriculture, Zanzibar 1950: 15-16. Forest Department, Zanzibar.

Special trial plots were initiated to fix up possibility and suitability of species for afforestation of brushwood country consisting mainly of *Heteropogon controtus* Sward on coral soils. Teak is one of the less successful species with good growth, seedlings were planted in holes prepared in the coral rocks filled with soil.

1861 Fraser, H. 1956. **Forest preservation in the Windward Islands**. Caribbean Forester 17(1/2): 25-28.

A note on the local value of forests with recommendations for their treatment. Teak is found best for the open land with poorer vegetation.

1862 Garcia, C.J.R. 1978. **Preliminary evaluation of experimental plantings of forest trees in savannas in the El Irel Experiment Station at Barrancas, Barinas State, Venezuela**. Revista Forestal Venezolana 28: 97-143**.**

Survival and growth of the forest species including teak were evaluated in pure or mixed plots from 1969 to 1973. Teak was one of the most promising species for afforestation of savannas in the Llanos Occidentales region of Venezuela.

1863 Geary, T.F; Briscoe, C.B. 1972. **Tree species for plantations in the granatic uplands of Puerto Rico**. Forest Service Research Paper ITF-14 (September 1972): 3p. Institute of Tropical Forestry Rio Piedras, Puerto Rico.

Tectona grandis was planted with 80 percentage success out of thirty two species were tried.

1864 Ghosh, R.C. 1961. **Teak is introduced in the lateritic waste**. Proceedings of the 10th Silvicultural Conference, Dehra Dun, 1961 Part II: 368-377**.**

In the lateritic waste of West Bengal, different measures were taken to rehabilitate them with various forest species including teak for reforestation. Teak is found the most promising species.

1865 Ghosh, R.C. 1977. **Handbook on afforestation techniques**. Government of India, New Delhi.

1866 Guwaldi, S.V. 1945. **Post-war reconstruction and our forests**. Indian Forester 71: 342-345**.**

Teak was used much for construction purpose as supplies of teak were plentiful and fairly cheap before. Because of industrialisation it is suggested to encourage plantations of species likely to be useful in the development of big industries such as those of plywood, pulp, raw rubber, etc. The author proposes that there should be no exploitation beyond the minimum necessary, a complete enumeration of the stock of valuable timber especially teak, new working plans to suit the actual conditions and permanent restriction of teak exploitation to the minimum. An intensive planting programme and tending of existing plantations are the other requisites suggested for restoring the situation.

1867 Hamilton, A.P.E. 1947. **Chambal ravines reclamation scheme**. Indian Forester 73(3): 99-101**.**

An afforestation scheme was begun with the object of preventing erosion in areas adjoining the Chambal River in Gwalior State and providing firewood, small timber and fodder for the local population. Species which have done quite well include *Tectona grandis*.

1868 Hashim, S; Zainudin, H.M.A. 1983. **The planting of speciality wood in the state of Kedah**. Malaysian Forester 46(3): 316-326**.**

Teak is regarded as the most promising high-grade timber species for the dry region of Malaysia. Details are given of a planting programme begun by the Forest Department of this state in 1982 along main roads and in village communities and in 1983 in areas of derelict forest.

1869 Healey, S.P; Gara, R.I. 2003. **The effect of a teak (*Tectona grandis*) plantation on the establishment of native species in an abandoned pasture in Costa Rica**. Forest Ecology and Management 176(1-3): 497-507**.**

A study is made to examine the ecological effects of establishing a teak plantation on an abandoned pasture in southwestern Costa Rica. The understorey of a 10 year old teak plantation was evaluated in terms of structure, species richness and diversity. Recruitment in the plantation's understorey was then compared to the recruitment present in nearby abandoned agricultural land.

1870 Hedegart, T. 1988. **The teak (*Tectona grandis*) plantations at Longuza, Kwamkoro and Kolekole forest reserves - an evaluation of the existing plantations and their management and recommendations for amendments and future establishment practice**. Amani Forest Inventory and Management Plan Project, Helsinki: 15p.

1871 Hendaris, D. 1988. **The establishment of timber estates in Sumbawa, West Nusa Tenggara, in 1987/1988**. Duta Rimba 14(99/100): 16-28**.**

An account of the early work in the establishment of forest plantations including *Tectona grandis* in West Nusa Tenggara, Indonesia, under the auspices of the Timber Estate Programme of the Ministry of Forestry is given. Perum Perhutani, the Forest State Corporation of Indonesia has been assigned to plant an area of 30 000 ha.

1872 Higbee, E.C. 1944. **The canal zone experiment gardens**. Agriculture in the Americas 4(8): 146-147.

The organization founded in 1923 mainly to assist farmers is now producing seeds and seedlings of teak, rubber etc. and is also carrying out experiments on growing teak.

1873 Hoare, P; Patanapongsa, N. 1988. **Long-rotation, high value trees: An alternative strategy for private forestry**. Commonwealth Forestry Review 67(4): 351-361.

Based on the experience with *Tectona grandis* in N. Thailand, it is recommended for a change in forestry policy to promote *T. grandis* for private forestry and for social forestry projects.

1874 Hon, C.H; Matsumoto, K (Eds). 2000. **Proceedings of the seminar on high value timber species for plantation establishment - teak and mahoganies, 1-2 December 1998, Sabah**. JIRCAS Working Report 16: 124p.

Papers covering aspects of the establishment of enrichment planting in logged-over forests or reforestation on harvested areas, tending, pests and diseases, management, economics and yield, wood properties and marketing of teak and Mahogany are included. Six papers address experiences with teak in Malaysia.

1875 Jambhale, N.D; Patil, S.C; Patil, F.B; Patil, M.M. 1995. **Performance of eight tree species in saline soil at Rahuri**. Journal of Maharashtra Agricultural Universities 20(1): p118.

Performance of different tree species including *Tectona grandis* is evaluated.

1876 Kaewla-Iad, T. 1970. **Establishment period of teak at Mae-Huad Forest Lampang**. Proceedings of the 3rd National Forestry Conference, Royal Forest Department, Bangkok: 8p.

1877 Kartasubrata, Y. 1979. **Tumpangsari method for establishment of teak plantations in Java**. Tropical Agriculture Research Series 12: 97-105.

1878 Kaul, R.N; Gogate, M.G. 1993 . **Greening of forest grasslands in Nasik District**. 35p. National Afforestation and Eco Development Board, New Delhi.

An account is given of the work done in degraded forest areas in Nasik District, Maharashtra. About 9474 ha of degraded forest were developed by means of shrub, legume and grass propagation. This helped to a remarkable regeneration of endemic tree species including *Tectona grandis* in the area.

1879 Kayastha, B.P. 1976. **Planting hardwoods in the Tarai and Inner Tarai Region of Nepal**. Forestry 6: 3-9.

1880 Keh, K. 1996. **A review of the teak plantation establishment in Myanmar in the light of modern research findings: A constructive critique**. Forest Research Institute, Myanmar, Leaflet 1/95-96.

1881 Keth, S.K. 1997. **Whither goes Myanmar teak plantation establishment?** 11th World Forestry Congress, Turkey.

1882 Khan, M.A.W. 1973. **Rehabilitation of degraded teak forest**. Forestry Conference (Silvicultural Conference), 6-10 December 1973: p14. Forest Research Institute, Dehra Dun.

The degradation stage of teak forests are listed and a detailed review of the practices so far followed in rehabilitating these forests is given. The lacunae discovered in such management are high lighted. A new approach for thinning uneven teak stands of varying sized trees and differing growth potential is given. A new management system called preparatory improvement felling system is proposed as a specific remedy for rehabilitating high quality teak forests of degraded nature.

1883 Krishnapillay, B. 2002. **A manual for forest plantation establishment in Malaysia**. Forest Research Institute Malaysia, Kuala Lumpur: 286p.

This manual which includes information about the history of forest plantations in Malaysia, species for plantation consideration, soil, seeds, seedlings and planting stock, improvement of planting stock through selection and management of seed production areas, land clearing techniques without burning, plantation preparation, planting and tending, plantation diseases, insect pests, approaches to agroforestry and the financial analysis of plantation development with some examples. Details of the silviculture of species that are recommended for plantation development in Malaysia which include the silviculture of teak along with seven other species.

1884 Kumar, U; Jena, S.C. 1996. **Trial of integrated biotechnical approach in biological reclamation of coal mine spoil dumps in South-Eastern Coalfields Limited, Bilaspur (Madhya Pradesh)**. Indian Forester 122(12): 1085-1091.

A trial on biological reclamation was conducted at mine sites. Saplings of various multipurpose tree species including *Tectona grandis* were planted and inoculated with the cultures of mycorrhiza and Azotobacter. Between the rows of trees, mixtures of *Pennisetum pedicellatum*, *Heteropogon contortus* and *Stylosanthes hamata* were sown. This integrated approach has helped to control soil erosion, improve the physical and chemical properties of the soil and increase plant heights.

1885 Kumaran, S; Balasubramanian, V; Balasubramanian, A. 2003. **Screening of suitable tree species for the areas affected with tannery effluent**. Crop Research Hisar 25(3): 492-494.

A field experiment was conducted in Ranipet, Vellore in Tamil Nadu to investigate the tree species for areas affected with tannery effluent. The biometric observations like establishment percentage, plant height and number of branches per plant were recorded. Teak recorded poor establishment of 5.5 percent.

1886 Kunsi, E.D. 1923. **The status of cultivation question in teak forests**. (Dutch; German). Tectona 16: 817-822.

1887 Lanier, L. 1959. **Forest plantations in the central Ivory Coast**. (French). Revue Forestiere Francaise 11(8/9): 592-604.

An account of the region, methods of establishment and silvicultural treatment of teak plantations is given.

1888 Larp. 1972. **Laos-Australian reafforestation project (LARP)-Manual of operations**. Department of Foreign Affairs and Department of Forestry of Australian National University, Canberra, Australia and Forests and Water Department of Royal Laos Government Vieliane, Laos.

The manual includes information regarding the nursery, collection of seed from native trees, teak plantations in Laos and trial plots. The chapters on nursery and teak plantations deal with teak culture in great detail.

1889 Laurie, M.V. 1934. **Summary of current methods of raising teak plantations in Madras**. Proceedings of 4th Silvicultural Conference, Dehra Dun, 1934: p290.

1890 Laurie, M.V. 1940. **Pre-monsoon stump planting of teak in Upper Godaveri Division, Madras**. Indian Forester 66: 465-467.

Premonsoon planting experiments with teak root and shoot cuttings in Upper Godaveri Division show that best results are obtained by planting about three weeks before the break of the monsoon.

1891 Letourneux, C. 1952. **Reforestation**. Report to the Government of Thailand FAO/EPTA 47. FAO, Rome.

Deals with teak on the following heads-site assessment, silvicultural system, mechanization and planting.

1892 Levingston, R. 1967. **Reforestation with teak: Papua and New Guinea**. Pacific Bulletin 4: 41-44.

Plantations near Port Moresby are aimed at supplying timber and labour employment.

1893 Loetsch, F. 1958 . **The effects of shifting cultivation on the structure of tropical forests and river behaviour, as studied in Northern Siam**. (German). Repr. from. Erdkunde, Bonn 12(3): 182-205.

Analyses of the species composition of the closely intermingled parts of the forest containing or not containing teak suggests that the teak-free areas are secondary forests following shifting cultivation in the distant past, teak being by nature of its dispersal, the last species to reoccupy a site.

1894 Lopez Palacios, S. 1974. **Novelties in the Verbenaceae for Venezuela**. (Spanish). Pittieria 6: 13-28.

Includes descriptions of tree species including *Tectona grandis*, with notes of the places where they are cultivated in Venezuela.

1895 Louman, B; Leavasa, A; Ona, A. 1993. **Tree species selection for village woodlots on Markham Valley grasslands**. Klinkii 5(1): 4-10.

A tree species trial was set up at Atsunas, Papua New Guinea, on degraded grassland. Ten species including *Tectona grandis* were selected for the trial, based on their performance elsewhere and on the availability of seeds and other propagation material. 18

months after planting, only the two *Leucaena* spp. and *Tectona grandis* survived.

1896 Loyttyniemi, K. 1987. **On survival of mukusi (*Baikiaea plurijuga* Harms) seedlings in the teak forests and in the Copperbelt**. Division of Forest Research, Forest Department, Zambia, Research Note 40: 8p.

Survival of seedlings at Chati in the Copperbelt, was compared with that at Masese in the teak forests. In the teak forests all the planted seedlings perished two months from planting, mainly due to animal damage; the directly sown seedlings survived better.

1897 Lugt, C.S. 1908. **Cultivation of teak seedlings and the so-called contact cultivation**. Tectona 1: p174; p441.

1898 Lwin, K. 2003. **Enrichment planting with teak - A potential tool for rehabilitation of degraded teak bearing forests in Myanmar**. TEAKNET 31: 4-6.

Results of the work done to improve the regeneration density of teak in the degraded teak bearing forests of Myanmar by line planting are presented.

1899 Madoffe, S.S. 1980. **Performance of tree species at Longuza arboretum, Muheza, Tanzania**. Tanzania Silviculture Research Note 33: 13p.

Information from species trials at Longuza arboretum was assessed to find species suitable for afforestation for Longuza Forest Project.

1900 Maessen, P.P.T.M. 2001. **Aspects of teak cultivation in Costa Rica**. (Dutch). Nederlands Bosbouwtijdschrift 73(1): 6-18.

The development of teak plantations is described with special reference to predictions of average annual increment, teak quality and prices. The establishment and management of plantations is outlined and damage by forest fires, pests and plant diseases is described. The need for certification and monitoring of growth are discussed.

1901 Meniaud, J. 1931. **Cultivation of teak in tropical Africa**. Empire Forestry Journal 10: p125.

1902 Mensbruge, G de la. 1968. **Afforestation species for the savanna**. Conference on agricultural research priorities for economic development in Africa, Abidjan Vol. II. U.S. National Academy of Sciences, Washington: 346-354.

The most promising species in the Guinea savanna of the Ivory Coast include *Tectona grandis*.

1903 Mijers, W.N. 1941. **Reforestation in Madura**. (Dutch). Tectona 34: 909-939.

A survey was made in 1936 and a scheme of afforestation was presented. The species to be planted are listed. Teak is recommended for most of the lime soils.

1904 Mijers, W.N. 1941. **Reforestation in Madura**. Tectona 34: 505-506.

It is found that out of the forests of about 70,000 ha., 60,000 ha. were teak forest. These forests are found disappearing rapidly through overcutting and a scheme was approved for the reforestation of 20,590 ha. in 1939.

1905 Ministry of Agricultural and Water Resources, Nigeria. 1964. **Western Nigeria teak plantation project**. 30p. Ministry of Agricultural and Water Resources, Forestry Division, Ibadan, Nigeria.

1906 Moeljodihardjo, G. 1993. **Rehabilitation of Gombong Forest area**. Duta Rimba 1(153/154): 10-13.

Rehabilitation measures carried out in cooperation with the local community since 1988 are described in 4230.7 ha of degraded teak forest in Sewu range, South Gombong, Java. The measures involved agroforestry and social forestry techniques.

1907 Mohan, A; Kulkarni, P.K. 1995. **Improved technique of teak planting**. Indian Forester 121(6): 447-454.

An improved cost effective method for teak planting is described. The method involved planting stumps using a crow bar on mini-terraces formed on sloping areas in the Western Ghats of Maharashtra.

1908 Moore, D. 1966. **The formations of teak plantations by the group planting system**. Proceedings of the 6th World Forestry Congress, Madrid, Vol. 2: 2530-2533.

1909 Mueller, L.G. 1977. **The national reforestation programme in Liberia**. (German). Allgemeine Forstzeitschrift 32(39): 977-978.

Plantations of the species *Gmelina arborea* and *Tectona grandis* are being evaluated.

1910 Mulard, M. 1961. **Afforestation in Upper Volta**. (French). Centre Technique Forestier Tropical, Nogent-sur-Marne: 26p.

Nursery practice, plantation methods, costs and yields of plantations including *Tectona grandis* established between 1940 and 1960 are discussed.

1911 Naidu, K.K. 1957. **Past, present and future of planting teak in the Andamans**. Indian Forester 83(9): 539-545.

Teak planting was abandoned some twenty five years ago, but recent trials using modern techniques show promise. Recommended methods are careful choice of site, pre-monsoon planting preceded by clear-felling, burning and interplanting with a crop of hill paddy.

1912 Nicholson, D.I. 1974. **Restoration of bauxite mines at Weipa**. Department of Forestry, Queensland, Research Paper 5: 30p.

Trial plantings of various tree species have been made annually since 1967. A total of thirty four species have been planted; details are given of the eleven most promising species including teak.

1913 Niskanen, A. 1998. **Value of external environment impacts of reforestation in Thailand**. Ecological Economics 26(3): 287-297.

1914 Oever, H.Ten. 1908. **Cultivation of seedling under contract**. Tectona 1: p213.

1915 Oo, M.T; Hlaing, C. 1998. **Greater reforms in teak plantation establishment and management**. TEAKNET Newsletter, 10 March 1998.

1916 Osorio, R; Sutherland, S. 1993. **Cost of establishment of *Tectona grandis* in sites infested with *Saccharum spontaneum* in Quebrada Ancha, Colon, Panama**. Silvoenergia 53: 4p. Proyecto Cultivo de Arboles de Uso Multiple, Turrialba, Costa Rica.

1917 Parry, M.S. 1954. **Tree planting in Tanganayika IV, species for coastal areas: Teak**. Empire African Agricultural Journal 20(1): p49.

Trial plots indicated good growth of teak in moister lowland areas and foot-hills upto 3000 ft. Short notes was given on sites suitable and also on methods of planting.

1918 Patel, V.J. 1997. **Teak cultivation at Jivrajbhal Patel Agroforestry Centre**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 15-19. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

The paper discusses the technique developed to increase the rate of growth of teak under density plantation with soil working, irrigation, fertilizer and pesticide application. The plantation has shown excellent growth in terms of diameter and height, promising very high income.

1919 Pedroso, L.M. 1973. **Data on the present performance of exotic species in the region of central Amazonas**. (Portuguese). Brasil Florestal 4(16): 64-68.

Tabulates data on the performance of exotics including *Tectona grandis* planted on sites 70 and 150 m above mean river level.

1920 Perera, W.R.H; Ranatunga, M.S. 1972. **Forestry in Sri Lanka**. Sri Lanka Forester 10(3/4): 62-131.

Forestry Development Plan includes forest policy, long-term objectives of timber production, plans for planting 16 000 acres and staff requirements. Papers included are; A study of the protective benefits of the Wet Zone forestry reserves of Sri Lanka; Notes on the planting of forest species; and Forests, trees and timber including illustrated account of different types of plantation and the general use of chena or taungya in teak plantations.

1921 Periera, W.E. 1920. **Establishing teak in an area of mixed jungle species**. Indian Forester 45(10), 1919: 545-546; 46(3): 156-157.

Describes the method of raising teak successfully in a mixed forest without burning the area. Success of the plantation is attributed to elimination of all useless species, weeding of the entire area and aeration of the soil.

1922 Piotto, D; Montagnini, F; Ugalde, L; Kanninen, M. 2003. **Performance of forest plantations in small and medium sized farms in the Atlantic lowlands of Costa Rica**. Forest Ecology and Management 175(1-3): 195-204.

Evaluated the growth of the native and exotic tree species including teak plantations in small and medium sized farms in the Atlantic humid lowlands of Costa Rica.

1923 Popham, S. 1982. **Burma teak (*Tectona grandis*)**. Bulletin of Pacific Tropical Botanical Garden 12(3): 56-59.

Discussed the cultivation and wood properties of the Burma teak.

1924 Prasad, R. 1992. **Performance of teak stumps planted on coal mine overburden dumps at Dhanpuri, Shahdol in Madhya Pradesh**. Vaniki Sandesh 16(2): 3-4.

1925 Prasad, R; Dhuria, S.S. 1989. **Reclamation of iron-ore mined-out areas: Biomass production efficiency of species**. Journal of Tropical Forestry 5(1): 51-56.

Afforestation trials with seventeen species are reported from an opencast iron-ore mined out area at Dalli-Rajhara in the Durg district of Madhya Pradesh. Species tried included *Tectona grandis*.

1926 Raets, G.H. 1965. **Preliminary report on the cultivation of *Tectona grandis* in the Barinitas experimental area, Venezuela**. (Spanish). Boletin, Instituto Forestal Latino Americano 18: 29-40.

Gives brief information on the natural vegetation, climate and soils, an experimental area in Barinitas that seems to confirm to the optimum conditions for teak and describes the results of trials. Best results were obtained with 8-month-old stumped plants, spaced 2 X 2 m.

1927 Rodrigo, J.C.P.N.A. 1960. **The silviculture, origin and method of raising teak in Ceylon**. Southern Forest Rangers College Magazine 36(4): 30-32. Forest Research Institute, Dehra Dun.

1928 Rodriguez Marcano, A. 1963. **The cultivation of *Tectona grandis* in Venezuela: General information and preliminary results of some trials**. (Spanish). Revista Forestal Venezolana 6(8/9): 49-72.

Lists 10 plantations of importance in Venezuela and gives information on their climate, soils, history and development. The results indicate that conditions near the optimum for teak exist in parts of the country. Teak appears to hold great promise for Venezuela.

1929 Rodriguez, D; Fonseca, W. 1993. **Results of a species trial in Palmar Norte, Costa Rica**. Resultados de un ensayo de especies forestales en Palmar Norte, Costa Rica. Ciencias-Ambientales 9: 48-53.

The results are reported of trials with eleven species including *Tectona grandis*.

1930 Roosendael, J van. 1931. **Observations on cultivation of Tectona**. Tectona 24: 954-983.

1931 Ross, P. 1959. **Teak in Trinidad**. Economic Botany 13(1): 30-40.

A note on the method of establishing and tending and local utilization, including that of thinnings. Age class distribution in the 10,000 acres planted, yield table up to 20 years and finance of hot and cold impregnation are given.

1932 Sakurai, S; Cruz, L.U de la. 1993. **Growth of trees planted in degraded forest land**. JARQ, Japan Agricultural Research Quarterly 27(1): 61-69.

Fast growing tree species planted in the Makiling forest in Los Banos, Laguna and degraded forest land in Carranglan in the Philippines were examined to analyse the characteristics and productivity of these tree species in each area. Teak was a fire-tolerant species and gradually improved its growth.

1933 San Buenaventura, P. 1961. **Reforestation of Imperata waste lands in Philippines**. Philippine Journal of Forestry 14(1/4): 67-76.

An account of the reforestation scheme, with photos of plantations of teak and other species.

1934 Sato, T. 1988. **A report of field experiences of tree planting in the Philippines**. Tropical Forestry 12: 45-50.

Species planted include *Tectona grandis*.

1935 Schaeffer. 1914. **Teak cultivation in Java**. International Institute of Agriculture Monthly Bulletin 3.

1936 Schwartz, P.B; Madzlan Hj. Ahmad; Ho, C.P. 1976. **Notes on an experimental introduction of teak (*Tectona grandis*) into Sarawak, Malaysia**. Planter 52(609): 459-466.

1937 Seubert, R. 1897. **Observations on teak cultivation in Dutch East Indies**. Allg. Forest-u. Jagdztg 73: p73.

Describes the methods adopted for obtaining natural regeneration of teak in Java and Madura and recommends methods of artificial regeneration of teak.

1938 Seubert, R. 1897. **The cultivation of teak in the Dutch Netherlands**. Indian Forester 23(b): 195-201.

Describes the methods adopted for obtaining natural regeneration of teak in Java and Madura and recommends methods of artificial regeneration of teak.

1939 Sharma, S.K. 1979. **Enrichment of tropical moist deciduous forests by planting in Andaman Islands**. Indian Forester 105(4): 260-273.

The history of enrichment planting in the islands is briefly reviewed. Teak is the main species used. The methods used for planting are described. Growth data are presented for enrichment plantings of teak in regeneration areas.

1940 Sieverts, A. 1956. **The cultivation of teak in Java**. IUFRO, 12th Congress, Oxford, 1956 IUFRO/56/22/12: 2p.

Briefly describes a successful method of regeneration by direct sowing in contour trenches with a cover crop of *Leucaena glauca* between the rows.

1941 Simatupang, M.H. 2000. **Some notes on the origin and establishment of teak forest (*Tectona grandis* Linn.f.) in Java, Indonesia**. Potentials and opportunities in marketing and trade of plantation teak: Challenge for the new millenium. Proceedings of 3rd Regional Seminar on Teak, Indonesia, 31 July-4 August 2000: 91-98.

1942 Singh, J. 1994. **Biodiversity afforestation model. An approach**. Indian Forester 120(9): 860-867.

Systematic efforts have been made to integrate the concept of biodiversity into an afforestation programme in East Melghat Forest Division, Maharashtra. The choice of species was based on the species composition of the natural forests of the area, modified to take account of various management considerations. The methodology used is described, including nursery aspects and planting design. Each unit is planted with 1250 teak plants and 1250 mixed species. A detailed model layout is given which is composed of subunits of different species composition.

1943 Smythies, E.A. 1930. **The introduction of teak in the United Provinces**. Indian Forester 56(9): 371-376; 57, 1931: p44.

During the last ten years large scale teak planting started in various divisions of United Provinces. The method of planting and rate of growth is indicated and the problem of pure teak plantations is discussed. The policy of future teak introduction in United Provinces is outlined.

1944 Soerianegara, I; Mansuri. 1994. **Factors which determine the success of regreening in Gunung Kidul, Central Java**. Workshop on the rehabilitation of degraded tropical forest lands, November 1991, University of Queensland, Brisbane, Australia. Journal of Tropical Forest Science 7(1): 64-75.

This investigation was carried out in villages participating in the regreening programme in Yogyakarta Province, Central Java. Species used in the regreening programme include *Tectona grandis*. The highest percentage of success of 54.6 percent was reached by *Tectona grandis*. The species most preferred by the villagers were *Tectona grandis* and *Acacia auriculiformis* .

1945 Soesilotomo, P.S; Soenarya, Y. 1991. **Planning of enrichment programme in Bojonegoro Forest District**. Duta Rimba 18(137/138): 7-14.

For teak plantations in Java.

1946 Somarriba, E; Beer, J; Morataya, R; Calvo, G. 1999. **Line planting of *Tectona grandis* Linn.f. in the humid tropics of Costa Rica and Panama**. (Spanish). Revista Forestal Centroamericana 28: 15-21.

The effects of site characteristics on survival, growth and financial gain with line planting of teak established in Talamanca, Costa Rica and Changuinola, Panama were analysed. Teak performed best on well drained alluvial soils, with a water table below 50 cm and with early natural regrowth. It grew well on sandy soils under laid with coral. Timber production from teak line planting is found very attractive.

1947 Srivastava, A.K. 2000. **An experience with irrigated teak plantation at sanghinagar in India**. Bio technology applications for reforestation and biodiversity conservation. Proceedings of the 8th International Workshop of BIO REFOR, Kathmandu, Nepal, 28 November-2 December 1999: 31-33. M.S. Bista; R.B. Joshi; S.M. Amatya; A.V. Parajuli; M.K. Adhikari; H.K. Saiju; R. Thakur; K. Suzuki; K. Ishii, Eds. BIO REFOR, Ministry of Forests and Soil Conservation, Kathmandu, Nepal.

The site was earlier partly agricultural land and partly fallow. The site condition is very poor with murram type soil and low under ground water table and having low rainfall around 700 mm. The irrigation and general silvicultural techniques of the plantations are described.

1948 Srivastava, P. 1994. **Present status of reforestation in PNG: Research needs**. JIRCAS International Symposium Series, Japan, March, 1994, No.1: 120-130.

About 42,000 ha of plantations have been raised of which include teak. The paper reviews the present status of reforestation, constraints and problems leading to the priorities of research for the management of logged-over forests including the rehabilitation of degraded areas.

1949 State Agricultural University, Wageningen. 1973. **Afforestation of eroded soils in Java (Indonesia)**. 64p. State Agricultural University, Wageningen, Netherlands.

The site requirements of seventy five tree species are listed and indications are given of those which are suitable for afforestation in the study area. Those recommended for the main reforestation areas include *Tectona grandis*.

1950 Subramaniam, B.A. 1956. **Teak plantations in the Andamans**. Indian Forester 82(4): 190-194.

Gives a short account of the history and growth data of the plantations. It is indicated that teak will grow well in the Andamans.

1951 Swaminath, M.H. 1992. **Advances in afforestation technology**. 320p. Prabha Publishing, Jayanagar.

Principles and practices for afforestation in India are presented. Chapters are on individual species/families, seeds, nursery, land preparation, time of planting, field conditions and planting operations, nutrient management in plantations, soil working and intercultivation - i.e. periodic cultivation within plantations, pest and disease management, soil and moisture conservation, coppicing, thinning and pruning, protection, agroforestry - including the use of plantation crops, farm forestry, social forestry and intercropping, methods of vegetative propagation of different species including *Tectona grandis*. Information on seed collection and nursery techniques for some important forest species is appended and a short bibliography is included.

1952 Taggarse, P.M. 1945. **My impressions on the general principles of teak plantation**. Indian Forester 71(9): 303-304.

The author is of the opinion that the growth of a teak plantation after the first ten years depends mainly on the nature of the subsoil and the level of the water table, deterioration of the soil is bound to result in one rotation of teak and is avoidable only by growing another species in the second rotation, exposure owing to clear felling results in soil erosion, defoliation cannot be controlled by leaving broad strips of natural forest between plantations, the formation of heartwood is slower in plantations than in natural forest and if it starts early its future is unpromising, epicormics are caused by hard subsoil and their growth is stimulated by opening-up, the main problem of teak plantations is that of revenue and expenditure.

1953 Tariel, J. 1966. **Teak in the Ivory Coast**. (French). Bois et Forests des Tropiques 107: 27-47.

Outlines the soils and climate of the region, the system of establishing plantations in the Bakoue region and examines problems involved.

1954 Thyagarajan, M. 1959. **Teak planting along fringes of water-course in Delta areas**. Proceedings of All-India Teak Study Tour and Symposium, December 1957-January 1958, Dehra Dun: p188.

Describes teak planting techniques, along the fringes of lakes, rivers and canals in Madras state.

1955 Tjau, I.K. 1953. **Mechanical ploughing in the forest division of S. Banjuwangi**. (Javanese). Rimba Indonesia 2(8/9): 346-348.

Dealt with the successful experimental ploughing of *Imperata cylindrica* done in the teak forest and afforested with teak.

1956 Vaclav, E; Skoupy, J. 1972. **Growing of teak (*Tectona grandis* Linn.f.) in Bangladesh**. Silvaecultura Tropica et Subtropica 2: 11-28.

Traces the history of experience with teak since its introduction in 1871. It is introduced from Burma. Discussed with the climate and soils, forest communities, seed production and pre-treatment, sowing, planting methods, establishment of plantations, tending, pests and damage by cyclones.

1957 Wepf, W. 1954. **Teak cultivation in Java**. (Dutch; Javanese). Rimba Indonesia 3(8/10): 378-416.

Discusses the development of the taungya system, cultivation methods, value of artificial rather than natural regeneration, the need for avoiding competition with other trees, the value of interplanting, chiefly with *Leucaena glauca*, and the treatment of the interplanted crop.

1958 Wilson, P.H. 1987. **The importance of stump size in establishing plantations of *Gmelina arborea* and *Tectona grandis***. Forestry Division, Solomon Islands, Forest Research Note 31-3-87: 9p.

Trials were undertaken to determine the best size of stump planting stock for establishment of vigorous plantations. Four stump size classes based on root collar diameter were tested. The results showed that smaller sizes give the best results.

1959 Wilson, P.H. 1988. **An investigation into planting methods**. Forestry Division, Solomon Islands, Forest Research Note 44-12-88: 6p.

Tested three types of preplanting cultivation - notching, dibbling and pitting - to identify whether survival and early growth were affected. Trials were carried out using stumps for *Tectona grandis*.

1960 Wiroatmodjo, R.S. 1955. **Increasing teak production in Java**. (Javanese). Rimba Indonesia 4(9/12): 378-409.

Certain recommendations are made for increasing the teak production in Java. Planting deforested areas, thinnings based on canopy density, road-building to allow of thinning in areas at present inaccessible, selection felling in the fifth decade to accelerate increment, economical crosscutting, use of appropriate silvicultural systems in areas unsuitable for clear felling, use of the financial rotation and intensive management to improve soil conditions and to allow shorter rotations are the recommendations made.

1961 Wyatt Smith, J. 1957. **A note on teak in northwest Malaya**. Malaysian Forester 20(3): 129-139.

Gives data for the Langkawi plantation established in 1909 with details of climate, soil and nursery and planting techniques. Recommendations include spacings of 12 X 12 or 12 X 16 ft., light alluvial soil, use of stump plants rather than cuttings and of Javan rather than Thailand stock and burning to reduce competition.

1962 Wycherley, P.R. 1962. **Suggestions for further investigations on teak in north-west Malaya**. Malaysian Forester 25(1): 5-14.

There are promising teak plantings in North-West Malaya. It is found that teak can be established as an economic plantation timber crop in the area.

1963 Yamada, H. 2002. **Planting trials at degraded forest lands in the northeast Thailand**. (Japanese). Tropical Forestry 53: 57-65.

The results of the species trials made with different species including *Tectona grandis* are reported.

1964 Zuhaidi, A.Y; Ab Rasip, A.G; Noor Mahat, M; Wahab, M.A; Wickneswari, R; Nik Zanariah, N.H (Eds). 1998. **Commercial cultivation of teak, sentang, Acacia and Hevea for timber: Proceedings of the Seminar, 9 January 1997, Kuala Lumpur**. (English; Malay). 64p. Forest Research Institute Malaysia, Kuala Lumpur.

The following papers on teak cultivation are included 1. Prospects for forest plantation in Malaysia: Potentials and challenges 2. Viability of planting teak and sentang in Malaysia. 3. Commercial cultivation and utilisation of teak and sentang in Thailand. 4. Commercial experience in tree plantation establishment.

1965 Zwart, W. 1911. **Cultivation**. Tectona 4: 35-41.

Go top

Plantation Techniques and Management

(See also 0170, 0190, 0194, 2406, 4648)

1966 **Cutting of bamboo shoots in order to favour teak**. Indian Forester 21, 1895: p265.

Recommends method of cultural operation and cutting bamboo to promote growth of teak.

1967 **Teak plantations in Ceylon, Extract from Ceylon Forester**. Indian Forester 22(2), 1896: 444-446.

Notes from teak plantation experience of Ceylon is given of nursery methods, planting and planting methods including costs.

1968 **A note from the Myodwin teak plantations**. Indian Forester 29(10), 1903: 458-459.

Describes young plantations at Forest Bungalow occupied by Dr. Brandis of early seventies in all vigour and the house and village are in ruins and abandoned with photographs.

1969 **Notes on thinning and sale of thinnings**. Tectona 4, 1911: 434-436.

1970 **Teak plantations**. Indian Forester 48(10), 1922: p561.

The writer argues for wider spacing of 20 to 30 ft. to save labour, weeding convenience and planting larger areas.

1971 **The problem of the pure teak plantation**. Indian Forester 58(12), 1923: 720-721.

Mr. H.G. Champion's article on the subject was reviewed and concludes accurate comparative data are lacking to prove the changes of bad growth, epicormic branching, fall in growth rate, fluting and damage severely by bee-hole borer. The problem of mixtures is discussed and the mistaken past management of Nilambur Teak Plantations in clearing all undergrowth is stressed as main cause of alarm.

1972 **Some notes and problems of the Central Provinces teak areas**. Indian Forester 50(11), 1924: 567-572.

For better yield of teak from natural forests the paper discusses silvicultural and management practices to be followed.

1973 **Comparison of methods of treating teak in India and Dutch East Indies**. Forestl JBER, 1925: p192.

1974 **Thinning teak areas**. Indian Forester 52(3), 1926: p133.

Discusses thinning marking of teak.

1975 **Thinning teak areas**. Indian Forester 53(12), 1927: p743.

Recommends pruning for silvicultural grounds for providing space and reducing competition with left-over stems and comments on marking procedures.

1976 **Burning on areas to be planted with teak**. Indian Forester 58(5), 1932: 288-289.

1977 **The teak plantations of Togoland**. (French). Revue International des Products Colonianx et due material colonial 21(199): p62; Revue Internationale du Bois 13(105), 1946: p71.

Teak was introduced into Togoland in 1901 by the Germans. The French administration has continued to plant teak and there are now more than 4 million trees. The German plantations was a mixed plantation, but the French have planted Teak pure, which greatly facilitates thinning and has not so far caused outbreaks of insects or fungi.

1978 **Effect of planting espacement**. Forest Research in India and Burma, Part II, 1947: p53.

Drawing from Nilambur experiments an espacement of 8.5 x 8.5' was recommended not with standing the tendency of branching which gives better height growth due to wider spacing. The recommendation is based, if pruning is not costly and sawnwood from such espacement grown teak is not weak or defective.

1979 **Comparison of planting teak stumps in prepared pits and crow bar holes**. Forest Research in India and Burma 1948-49 Part II, 1949: p24.

The Central Provinces and Berar experience showed no appreciable differences between the two methods.

1980 **Effect of cost of different methods of weeding in teak plantations**. Forest Research in India and Burma 1948-49 Part II, 1949: p24.

It was observed that the effect of ploughing between the lines was very marked in preventing heavy growth of grass.

1981 **Thinning research in teak**. Forest Research in India and Burma 1948-49 Part II, 1949: p36.

Comparison of three grades of thinning carried out in Nilambur of 15 years old was discussed in the light of prescriptions of All India yield tables.

1982 **Pruning teak plantations**. Forest Research in India and Burma 1948-49 Part II, 1949: p36.

Madras experiments indicate feasibility of this operation to produce cleaner boles.

1983 **Teak: Dr. Craib's theory of thinnings in Nilambur - Results**. Extract of note from provincial Silviculturist (Mr. K.N.R. Nair to C.C.F. in Rc. 291/50 dt. 25-2-1950), 1950.

Gives a detailed note and discussion of results of applying Craib's theory of thinnings in Nilambur plantations.

1984 **Teak**. Forest Research in India Part II (1951-52), 1952: p113.

It is suggested that in areas with over 60" annual rainfall, wider espacement is safe and good.

1985 **Experimental plantations**. Forest Research in India Part II (1952-53), 1953: p4.

Storage experiments on teak stumps before planting with one week, two weeks and control tried in a 4 x 4 Latin Square design - indicated stumps without storage gave best results and 2 to 3 weeks storage worst results both in respect of survival and height growth.

1986 **Teak silviculture tested in two sites**. (English; Spanish). Caribbean Forester 14(1/2), 1953: 27-28; 59.

A report on plantations of *Tectona grandis* established on good sites in Puerto Rico.

1987 **Teak plantations by Coorg method**. Forest Research in India Part II (1952-53), 1953: p75.

Comparison of burning teak plants and cutting back in first year with control gave better survival and height growth for control and more uniform growth in burnt plots.

1988 **Experiment on burning grass and cutting back teak in areas covered with patches of grass in Tithimatti range**. Forest Research in India Part II 1953-54, 1954: 35-36.

Burning of grass in Thithimatti range has in no way helped the teak plants to put on better growth.

1989 **Garden experiment to determine the best period of planting teak and other species in Coorg**. Forest Research in India Part II 1953-54, 1954: 33-34.

Planting teak and other species in third week of May give best percentage of success followed by June first week planting.

1990 **Tending, thinning, climber and weeds**. Forest Research in India Part II 1954-55, 1955: p78.

Pruning in teak plantation does not appear to be beneficial.

1991 **Teak experiments on espacement**. Forest Research in India Part II 1954-55, 1955: p73.

Of the two espacements 6'x 6' and 8.5'x 8.5' it was observed that wider espacement give better height growth and planting and weeding costs is cheaper by 22 percent hence the same was adopted for 1951 onwards in Nilambur and Kannoth plantations.

1992 **Teak plantations-Wynaad-best intensity of thinning**. Forest Research in India Part II 1954-55, 1955: 78-79.

It is reported that different intensities of thinnings have no effect on height growth. Heavier grades of thinnings give progressively higher diameter increments. At the end of 16 years the yield of useful basal area decreases as the intensity of thinning increases and at the end of 16 years, the yield of total volume produced to date, decreases as intensity of thinning increases.

1993 **Teak plantations-heavy and early thinnings to anticipate and not to follow likely suppression**. Forest Research in India Part II 1954-55, 1955: p79.

It was found that heavy thinning to anticipate and not follow like suppression yields rapid diameter increment, but the total volume production is greater with an ordinary D-grade thinning as adopted in district practice.

1994 **Teak plantations: Wynaad-experiments to ascertain the best time for first thinning**. Forest Research in India Part II 1954-55, 1955: p78.

First thinning at the age of five years yields greater diameter in 21 years than first thinning at the age of 7 years or 9 years.

1995 **Records of forest plantation growth in Mexico, the West Indies and Central and South-America**. Caribbean Forester 21, 1960 .

Detailed accounts of area, number of stems per ha., age at present, and d.b.h. at various ages, locality factors like elevation, rainfall, soils and their pH, origin of seed, planting espacement and methods of planting, stocking, tending, thinning and pruning operations carried out and seed production and flowering are given.

1996 **Energy in the revival of teak**. (Thai; English). Vanasarn 21(2), 1963: 101-104.

Reports on revival of shoots from 23 cm pole - which sends up 0.92 to 1.06 metres shoots in one to 1.5 years and recommends on proper cutting.

1997 **Seminar on man made forest in Indonesia, 1970**. Laporan 100-102, 1969: 16-36.

Out of the three papers presented one paper was on the function of forest tree improvement in the development of industrial forests which recommends breeding programmes for *Tectona grandis*, *Pinus merkusii* and *Agathis loranthifolia*.

1998 **Silvicultural and economic studies for industrial reforestation in Panama**. (Spanish). 14p. Colegio de Ingenieros Forestales, Obarrio, Panama, 1990.

A general account of reforestation in Panama, covering trials, land availability, replanting costs, economic analysis, operations in plantation establishment and management, ecological zones, yields for the species including *Tectona grandis*, suitable sites and the urgent need for reforestation. The resources available for reforestation are discussed.

1999 **The forgotten forest**. Holz Zentralblatt 117(8), 1991: 126-127.

Benin discovers its timber as economic resource. Sustained management of teak plantations intended.

2000 Abayomi, J.O; Ekeke, B.A; Nwaigbo, L.C. 1985. **Some preliminary results of teak thinning trials in Nigeria**. Proceedings of the 15th Annual Conference of the Forestry Association of Nigeria, Yola, 25-29 November 1985: 290-299. J.A. Okojie; O.O. Okoro, Eds. Forestry Association of Nigeria, Nigeria.

Results are reported of analyses of variance of diameter increment and height increment of twelve teak thinning trials at six sites. Diameter increment tended to increase with thinning intensity, while height increment and basal area were less affected by thinning treatment.

2001 Abegbeihn, J.O. 1982. **Preliminary results of the effects of spacings on the growth and yield of *Tectona grandis* Linn.f.** Indian Forester 108(6): 423-430.

Measurements of g.b.h., height and volume were made of a 7-yr-old plantation raised at Nimbia, Nigeria in different spacing. It is found that spacing affect mean diameter and basal area but not mean and top height, form factor and total volume.

2002 Adekunle, A.O. 1964. **A conversion system for the management of coppiced teak plantations**. The role of forestry in the economic development of the savanna areas of Nigeria. Proceedings of the first Nigerian Forestry Conference, Kaduna, 1964: 189p.

2003 Adiody, P.N. 1959. **Recent trends in thinning of teak plantations in Nilambur**. All India Teak Study Tour and Symposium, December 1957-January 1958, Dehra Dun: 190p.

Gives experiments in thinning teak plantations and state experience in the matter.

2004 Ahmad, Y.S. 1935. **The Bamonpokri teak plantations**. Indian Forester 61(12): 786-790.

Describes the locality factors and tract, traces the history of teak plantations in this area. The method of raising the plantations is discussed with costs.

2005 Aleem, S.A. 1967. **Teak as a plantation species in Pakistan**. IV Teak Sub-Commission, FAO, Rome: 3p.

The climatic conditions for the growth of teak, past history, age, distribution of existing plantations, their technique and other characteristics are discussed and labour supply problems are outlined.

2006 Allsop, F. 1940. **Kyetpyugan teak plantation, Insein Forest Division, Burma**. Empire Forestry Journal 19: 43-47.

The Kyetpyugan teak plantations were started with a view to producing concentrated stocks of teak timber for export. But the site was ill-chosen and capable only of producing inferior quality of teak suitable only for local supply.

2007 Altona, T. 1922. **Djati en Hindoes. Oorsprong van het Djatibosch in Bodjonegeno Java**. (Indonesian; English). Tectona 15: 457-507.

Regular espacement of teak forests suggests of plantation origin attributed to Hindoo period of 14th to 16th century. Teak mixed with *Butea monosperma* and *Schleichera oleosa*, linguistic origin of the names, absence of mixed teak forests, presence of local Hindoo population and planting distance of 12-32 hastas all confirm this supposition.

2008 Altona, T. 1923. **Teak and Hindoos**. Tectona 16: 556-560.

Many teak forest in Java has been proved to be old plantations and could not be proved to have been planted. These old forests were planted by Hindoos. The frequency of old teak plantations and the absence of virgin forests make it very improbable that the teak tree is native.

2009 Appelman, F.J. 1926. **Crop rotation as a necessity in teak cultivation**. (Indonesian; English). Tectona 19: 835-842.

The author recommends crop rotation in soils lower in quality, which deteriorate under pure, poorly growing teak plantations-which may be alternated with crops of *Crotoleria* spp.

2010 Asa Prombubpa. 1974. **Study on the effect of different intensities of thinning on the increment of teak**. (Thai). Faculty of Forestry, Kasetsart University, Thailand, Research Note 9: 12p.

A study was made of the effects of thinning in *Tectona grandis* plantations in Lampang province, Thailand, removing 50, 60, 70 and 80 percent of the original basal area. The optimum intensity of thinning was taken as 50-60 percent.

2011 Aweto, A.O. 1990. **Plantation forestry and forest conservation in Nigeria**. Environmentalist 10(2): 127-134.

Shifting cultivation and logging are discussed as the main causes of forest depletion. The Nigerian government's response to rapid forest depletion has been to establish tree plantations, mainly of fast-growing exotics such as teak and *Gmelina arborea*.

2012 Bambang, A.S. 1981. **Thinning principles in teak forests**. (Indonesian; English). Duta Rimba 7(46): p3.

2013 Banjibhatana, D. 1959. **Silvicultural research and management of teak in Thailand**. Royal Forest Department, Bangkok.

The silvicultural research programme on teak and other tree species in Thailand were studied.

2014 Barnard, R.C. 1953. **Experience with exotic tree species in Malaya**. Malaysian Forester 16(1): 29-40.

Includes notes on nursery and plantation experience with different species including *Tectona grandis*.

2015 Barrott, H.N. 1968. **The Nimbia timber plantation project: Teak**. Bulletin of Nigerian Forest Department.

2016 Becking, J.H. 1941. **The rotation for teak forests in Java**. (Dutch). Tectona 34: 507-514.

The most desirable rotation for teak in state forests has been calculated at 125-135 years for fully stocked stands.

2017 Becking, J.H. 1951. **Forestry technique in the teak forests of Java**. Proceedings of UNSCCUR, Lake Success 5: 106-114.

2018 Beekman, H. 1917. **Thinning and clearing of teak**. (Indonesian; English). Tectona 10: 685-694.

2019 Beekman, H. 1917. **Rotation for teak forests of Java treated under the clear cutting system**. Tectona 10: 995-1044.

2020 Beekman, H. 1918. **The correct rotation for teak stands**. (Indonesian; English). Meded Proefsta Boschw 13: 72-74.

Determination of correct rotation for planted teak and remaining natural teak forests is stressed. The financial, maximum volume of production and technical rotation are discussed and their inter-relationships are indicated. Corde's volume rotation of +/- 70 years is examined and the various methods of calculating financial/technical rotation are stressed and compared with British India.

2021 Beekman, H. 1936. **Rotation of teak plantations**. Tectona 29(2/3): 108-136.

Based on data available at FRI, Buitenzorg, the Bruce (1920) and Wulfing (1932) methods of preparing volume tables are questioned and concludes that 1920 data has no influence upon fixing financial rotation. The decrease in growth rate upto a certain age is counter-balanced by an increase in the ratio of marketable timber to the total product.

2022 Beekman, H.A.J.M. 1949. **Silviculture in Indonesia**. (Dutch). Publicatie van de Stichting `Fonds Landbouw Exportbureau 1916-1918', Wageningen 33: 386p.

Other than general papers, a series of comprehensive summaries of the available information on the biology and silviculture of four important species including *Tectona grandis* is included.

2023 Bellouard, P. 1952 . **Report on the French West Africa Federation**. (French). Proceedings of the 1st Conference of Forestry Inter African Countries, Abidjan, 1951: 33-120 .

Describes methods and results in close planting, enrichment by strips and natural regeneration, covers artificial regeneration of the savannas with indigenous and exotic spp. including teak.

2024 Betts, T.F. 1941. **The Tiv plantations - 1939 to 1941**. Farm and Forest 2: 110-113.

Plantation work was confined to the establishment of *Gmelina arborea* and teak on favorable sites and the protection and treatment of certain areas to improve conditions for the natural regrowth of woody vegetation. Encouragement was given to the planting on household surrounds.

2025 Beumee, J.G.B. 1918. **Development of young teak planted in Trinidad**. Tectona 11: 243-244.

2026 Beumee, J.G.B. 1922. **Results of the remeasuring of 40 permanent sample plots reserved for the investigations regarding thinning and yield of teak plantations**. (Indonesian; English). Tectona 15: 76p.

Results show that heavy thinning in suppressed forests of good or better quality increases volume of standing timber than low light thinning due to higher rate of growth of diameter but not height, in vigorous growing forests slight thinning impairs the development of large trees, slight thinning of dominant trees has same influence as heavy thinning of suppressed trees, thinning of dominant tree lightly results in freeing the crowns and increased volume of production by best formed trees, heavy thinning of dominant trees produces increased diameter growth, heavy partial clearance stimulates diameter growth at breast height.

2027 Billah, A.H.M.M. 2003. **Optimal rotation of teak production: Tools for economic analysis**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

An attempt is made to determine the optimal rotation of teak plantation in order to make management efficient and long term investment financially remunerative and attractive. It is found that ideal rotation for teak plantations would be 20-21 years. It is recommended for further research to arrive more realistic and accurate estimate of rotation for appropriate management and felling policy prescriptions.

2028 Blanford, H.R. 1923. **Spacing in teak plantations**. Indian Forester 49(1): 50-53.

Out of various spacings tried found 6'x6' espacement as ideal and wider or closer spacings as not very economical.

2029 Blanford, H.R. 1923. **Thinning in teak plantations**. Burma Forest Bulletin 9 (Silviculture Series 8): 6p.

Deals with first, second and subsequent thinnings and cleanings and suggestions are made on season and year at which thinnings should be carried out. Average spacing and number of stems per acre at different ages for past thinned and unthinned plantations are given.

2030 Blanford, H.R. 1923. **The effect of wide spacing in teak plantations**. Indian Forester 49(6): 301-303.

Compared the increment of two teak plantations of 9x9 ft. and 6x6 ft. espacement. The author comments on forking, height growth, etc. and concludes that tendency with forking with wider spacement counteracts the slight increase in diameter increment.

2031 Blanford, H.R. 1933. **Some Burma notes on the problem of pure teak plantations**. Forest Bulletin 78 [Indian Forester 59(7): 455-461].

Discusses fluted boles, epicormic shoots, defoliation, soil deterioration and erosion attributed to pure teak plantations. Their causes are mainly due to mistakes in past management are examined in detail and remedies suggested.

2032 Bohidar, N. 1951. **Thinning research in teak**. Madras Forest College Magazine 27(3): 140-147.

The paper describes the history of preparing yield tables of teak and subsequent research on thinning teak crops.

2033 Boonsomboon, P. 1965. **Comparison of survival percentage and growth of teak stumps of three years after planting with different kinds of stumps**. (Thailand). Student Thesis. Kasetsart University, Bangkok.

Teak stumps with root and without root have not given different height growths and survival is 89 and 87 percent respectively. Survival of stumps stored for one week (90 percent), two weeks (95 percent), three weeks (72.5 percent), four weeks (62.5 percent) and control (95 percent).

2034 Bose, R.K. 1909. **The best season for coppicing teak**. Indian Forester 35(12): 683-684.

Describes results of different seasons for coppicing in Indore forests. May coppicing appears best season with 3-4 vigorous coppice shoots per stool.

2035 Brascamp, E.H.B. 1914. **A visit to the Rembrangsche teak forest by J.B. Teysman in 1854**. (Indonesian; English). Tectona 7: 457-458.

2036 Brascamp, E.H.B. 1915. **Concurrence for teak thinning knife**. Tectona 8: p563.

2037 Brascamp, E.H.B. 1917. **Memoirs of an old member of the administration of wood forestry Mr. Daendels, quarter of a century later about the management of teak forests**. (Indonesian; English). Tectona 10: 586-590.

2038 Brascamp, E.H.B. 1917. **The teak forests: Memoirs of Mr. William Hendrik van Ostenberch, Gouverneur in Java in 1765: No.VI in Kolonial Archief**. (Indonesian). Tectona 10: 1045-1055.

2039 Brascamp, E.H.B. 1920. **Travels from Japara to D. Van Den Straten over Rembang and Blora near Pamolan to visit the teak forests**. (Indonesian; English). Tectona 13: 329-335.

2040 Briscoe, C.B; Nobles, R.W. 1966. **Effects of pruning teak**. Inst. Trop. For., Rio Piedras, U.S. For. Serv. Research Note ITF 11: 6p.

Results of the study on the incidence of adventitious branching, after pruning of 8- to 10-year *Tectona grandis* plantations at St. Croix, Virgin Islands are presented.

2041 Briscoe, C.B; Ybarra Coronado, R. 1971. **Increasing growth of established teak**. Institute of Tropical Forestry, United States Forest Service Research Note ITF-13: 7p [Commonwealth Forestry Review 51(4), 1972: 290-294].

Teak plantations in Puerto Rico, 3-16 years old, were thinned and fertilized. Removal of competitors is found to be the best method for increasing the rate of tree increment. Height growth was greater in the areas with higher rainfall. Both height and basal area growth were greater on the andesite-derived alluvial sites than on the residual soils over limestone. Basal area increment was positively correlated with total height growth with K.

2042 Brooks, R.L. 1941. **Notes on pure teak plantations in Trinidad**. Caribbean Forester 3: 25-28.

Pure Teak plantations in Trinidad were started in 1913 and are expanded at the rate of about 400 acres per annum, with a present total area of 2,100 acres . A list is given of standard practices adopted by a recent conference of technical officers.

2043 Brunck, F. 1972. **The use of weed-killers in tropical forest nurseries and plantations**. Bois et Forests Des Tropiques 141: 31-39.

Briefly reviewed the types of nursery and plantation work that involve the use of weed-killers.

2044 Bryant, C.L. 1968. **The effect of weed control on the growth of young teak in Tanzania**. Silviculture Section Forestry Division, Lushoto, Silviculture Research Note 8: 2p.

Trials of five weeding treatments showed that clean weeding of *Tectona grandis* planted on a rain-forest site in E. Usambara, increased first-year height by 57 percent vs. partial weeding and survival was also better.

2045 Budiantho, D. 1989 . **Influence of wider spacing of teak on mean diameter and space available for food crops in the taungya system**. (Indonesian). Buletin Penelitian Hutan 516: 13-26.

The results are reported of a study on teak spacing in Saradan Forest District, East Java. Greater distances between plants in the same row resulted in greater diameter growth of the stand, while wider distances between rows gave a larger intercropping area.

2046 Butterwick, A.J. 1932. **Early records of stump transplanting**. Indian Forester 58(11): 645-646.

The earliest mention is traced 1920 (Champion and Plant), while the author reports the use of the method mentioned in 1896 acc. to Bulletin No. 5, Agricultural Series, Department of Lands and Agriculture, N.W.P. Oudh under the head 'A new method of planting' practised about 8 years ago was described as useful for deciduous trees like teak and pyinkado, and thus the date of first stump-planting is traced to 1888.

2047 Chacko, K.C. 1998. **Silvicultural problems in management of teak plantations**. Teak for the Future: Proceedings of the Second Regional Seminar on Teak, Yangon, Myanmar, May 1995: 91-98.

Performance of plantations under high input management remains under investigated. The paper attempts to discuss various issues involved in teak plantation management and suggests alternatives for ensuring quality.

2048 Champion, H.G. 1932. **The problem of the pure teak plantations.** Indian Forest Bulletin 78.

The problems and advantages of mixed plantings was discussed, frequent and heavy thinnings were recommended for teak as this will be good both as soil cover and also contributes to increased productivity. Fire protection is recommended. From economic point of view - pure teak is considered as a viable and profitable proposition.

2049 Chaturvedi, J.K. 1961. **Coppice with reserve system**. Proceedings of the 10th Silvicultural Conference: 944-950. Forest Research Institute, Dehra Dun.

The distinctive features of the silvicultural system as applied in the management of dry deciduous forests of central India containing teak and other coppiceable species are discussed. This system in addition to meeting local, agricultural and small timber demands, preserves locality factors and improves the general quality and extent of growing stock.

2050 Chuasawan, W. 1985. **Plantation establishment methods and techniques in Thailand**. Proceedings, Workshop on nursery and plantation practices in the ASEAN, Jakarta, 3-7 October 1983: 239-258; 293-294. New Zealand Forest Service, Wellington, New Zealand.

Descriptions are given of nursery and plantation establishment techniques in general and for selected species for large-scale plantation establishment including *Tectona grandis*.

2051 Classen, J.C van R. 1915. **Answer to Mr. Soeters article "Rotation of teak forests, Tectona, July 1951"**. (Indonesian; English). Tectona 8: 848-853.

A general article in reply to Mr. Seeters comments on rotation of teak forests.

2052 Clifford, J.D. 1919. **The effects of thinnings on a young teak plantation**. Indian Forester 45(1): 16-18.

Thinning is considered beneficial to young teak plantation. In a 17 year old teak plantation in Pyinmana Division, Burma the above conclusion is arrived after a study of girth increment.

2053 Coster, C. 1932. **The burning out of plantation areas in the teak forests**. Tectona 25(2): 71-95.

A short discussion of theoretical advantages and disadvantages on burning vegetable waste in tropical soils to be planted with teak is given. Middle Java experiments by interplanting teak between rows of old stumps were described. Growth of teak was better under method.

2054 Danhof, G.N. 1941. **Business rotation of teak**. (Dutch). Tectona 34: 779-809.

It is reported that in teak forests in the Dutch Fast Indies, the rotation of the highest financial yield is only slightly more profitable than that of the highest income.

2055 Danhof, G.N. 1941. **Commercial rotation of the teak**. (Dutch). Tectona 34(10): 779-809.

It is reported that in the Dutch-East Indies, the rotation of the highest financial yield is only slightly more profitable than that of the highest income.

2056 Dembner, S.A; Perlis, A (Eds). 2000. **Teak - Special issue**. Unasylva 51(201): 65p.

Eight papers are included on various aspects of teak silviculture and management worldwide. A paper discusses the utilization of rubber wood as a substitute for teak in high-value products.

2057 Deventer, A.J van. 1913. **Note on the rotation time and regulation of trade in the teak forests of Java**. (Dutch; English). Tectona 6: 608-626.

2058 Dhareshwar, S.S. 1940. **Honavar range and teak regeneration. Part II**. Indian Forester 66: 345-349.

Yield statistics from a test plot appear to confirm the view expressed in a former article that 9 ft. X 9 ft. is the best spacing for teak in the Honavar range.

2059 Doorn, Z van. 1931. **Quality management of teak as a guiding principle for the treatment of stands**. Tectona 24: 984-987.

2060 Doorn, Z van. 1933. **Free rotation classes for regulating the operation of teak forests**. Tectona 26: 1-25; 352-358; 388-390; 551-557.

A reply is given by author for the debate on the topic.

2061 Doorn, Z van. 1936. **Considerations affecting the rotation in the teak forests of Java**. (Dutch). Tectona 29(1): 1-43.

2062 Drees, E.M. 1941. **An example of improvement in a teak stand through replanting**. (Dutch; English). Tectona 34(10): 772-774.

2063 Dupuy, B. 1992. **Plantations for timber production in dense rain forests of Africa**. Bois et Forests des Tropiques 231: 7-15.

A brief account is given of recent silvicultural techniques used in the establishment of tree plantations in tropical forests. The possible choice of species is outlined. Older plantations tended to be of indigenous, valuable species such as *Tectona grandis*.

2064 Edie A.G. 1916. **Thinnings of teak coppice in the Pole areas of Kanara**. Indian Forester 43(3): 157-159.

Describes experiments on the effect of thinning out of inferior coppice shoots on the growth stimulation in teak on the remaining shoots. Volume increment of thinned shoots is greater than unthinned ones. Recommends thinning after ten years.

2065 FAO. 1967. **Teak as an exotic plantation species in Burma**. FAO Asia Pacific and African Forestry Commission, Fourth Session, Rome FAO: T-67/4: 8p.

Outside natural range teak was planted in 2256 ac. in western and southern regions of Burma. Oldest teak plantations are over 100 years old. Climate, soil and natural regeneration are described. Details of establishment, tending and thinning techniques are given.

2066 Ferlin, G. 1970. **Memories of the Sudan**. (French). Bois et Forests des Tropiques 133: 3-15.

Gives a short illustrated account of forest management and silviculture in the Central Circle, Equatoria Division is given. Problems and techniques of afforestation with trees including teak are described.

2067 Forest Department, Andhra Pradesh. 1973. **Research Report of Silviculturist, Andhra Pradesh Forest Department for the years 1970-71 and 1971-72**. Andhra Pradesh Forest Department, Hyderabad: 1-56.

Teak experiments include grading of teak seed, use of pre-germinated seeds, different soil working intensities and nursery trials of different provenance seeds and fertilizer trials.

2068 Forest Department, Central Provinces and Nagpur. 1941. **Silviculturist's report March 1941**. Forest Department, Central Provinces and Nagpur: 71p. Government Printing Press, Central Provinces and Berar.

In planting with teak original high forest was clearfelled and slash burnt before planting. In well burnt slash patches growth of teak was vigorous.

2069 Forest Department, Madras. 1942. **On stump planting and control of branching and pruning in young teak plantations**. Annual Report on Silvicultural Research in the Madras Presidency for the year 1940-41: p38; 27; 84; 29.

Experiments in the stump planting of teak show that early stump planting is advantageous and that planting the stumps with the top 1 in shoot flush with the ground is beneficial both as regards survival and height growth.

2070 Forest Department, Sri Lanka. 1953. **Eradication of Illuk (*Imperata cylindrica*) in teak plantations**. Report of Conservation Forest, Ceylon 1953, Part 2, 1954: 26-27. Forest Department, Sri Lanka.

Successful experiments for eradication of *Imperata cylindrica* have been made by cultivating plantations. Cultivation is followed by sowing of *Tephrosia candida*. The establishment of this leguminous cover keeps out the Illuk. Result of the operation was the appearance of teak regeneration throughout the cultivated area.

2071 Forest Department, Sudan. 1954. **Weeding and planting methods for *Tectona grandis***. Report of Forest Department, Sudan 1952/53: 39-41 .

An experiment was laid out to investigate intensity of weeding, date of planting and type of plants in the establishment of plantations. Teak planted in June gave significantly better results than that planted in July or August. Weeded plots gave higher survival and better growth.

2072 Forest Department, Tamil Nadu. 1950. **Thinnings (teak) modified thinning cycle for Wyanaad Division**. Extract of Provincial Silviculturist, Ooty, Madras note Re. 1787 949 dt. 27-2-1950.

Mainly deals with thinnings in plantations of Wyanad division.

2073 Forest Research Institute, Dehra Dun. 1929. **The problem of pure teak plantation**. Proceedings of the 3rd Silvicultural Conference, Dehra Dun: p79.

2074 Forest Research Institute, Dehra Dun. 1934. **Problem of the pure teak plantation**. Proceedings of the 4th Silvicultural Conference, Dehra Dun: 126-136.

2075 Forest Research Institute, Dehra Dun. 1939. **A note on the teak plantation technique**. Proceedings of the 5th Silvicultural Conference, Dehra Dun.

Resolved to collect all available information on artificial regeneration and tending of teak.

2076 Forest Research Institute, Dehra Dun. 1967. **Thinning research**. Proceedings of the 11th Silvicultural Conference, Forest Research Institute, Dehra Dun: p615.

A series of comparative thinning trials based on correlated curve trend and other methods be laid out for species of economic importance including *Tectona grandis*.

2077 Forest Research Institute, Dehra Dun. 1983. **Thinnings**. Proceedings of the 11th Silvicultural Conference, Dehra Dun, 15-25 May 1983, Volume III: 1-16. Forest Research Institute & Colleges, Dehra Dun.

Four papers on thinnings in forest crops are included. Note on thinning in coppice crop of teak by Patel, R.I; Thinning by Partap Singh; Quantitative concept of thinning by Suri, S.K; Some results of preliminary trials carried out to test the method of thinning based on the concept of free crown space as compared to conventional classification of stems for thinning forest crops by Madan Mohan Singh.

2078 Foulkes, F. 1914. **Teak in Wynaad II: A study**. Indian Forester 40(6): 241-263.

In Wyanad, North Malabar, where free seedling reproduction is absent, the tree reproduces from coppice shoots and more from root suckers.

2079 Galloway, G; Ugalde Arias, L.A; Vasquez, W. 2001. **Importance of density reductions in tropical plantations: Experiences in Central America**. Forests, Trees and Livelihoods 11(3): 217-232.

Quantitative tree characteristics including live crown ratios, foliage biomass, height-diameter ratios and annual diameter and height increments are useful indicators of tree and stand vigour. Practical approaches to thinning are described for plantations of species including *Tectona grandis* in Central America.

2080 Garland, E.A. 1934. **Technique of teak plantation work**. Proceedings of 4th Silviculture Conference, Dehra Dun, 1934: p297.

2081 Gera, M; Gera, N; Singh, V.K. 2000 . **Rooting response of root cuttings of some MPT species under low cost mist conditions**. Indian Forester 126(2): 171-174.

A rooting trial was carried out using root cuttings of seven multipurpose tree species including teak in a low-cost mist chamber designed and developed at the Tropical Forest Research Institute, Jabalpur. *Tectona grandis* gave a very poor rooting response of 10.0 percent. The findings highlight the importance of vegetative propagation through root cuttings and its substantial scope in tree improvement programmes.

2082 Ghosh, R.C. 1965. **Teak plantations of North Bengal**. Indian Forester 91(2): 83-92.

Sketches the history of these plantations of 4500 ha., and gives climatic and increment data for a number of sites. It is reported that the experience gained during the past 100 years justifies further planting of teak.

2083 Ghosh, R.C; Singh, S.P. 1981. **Trends in rotation**. Indian Forester 107(6): 336-347.

The general trend towards shorter forest rotations in response to growing timber needs and the ability to utilize smaller-diameter timber is discussed. Information is given on rotations currently used for major Indian timber species including teak.

2084 Goot, T van der. 1932. **The elimination of alang-alang (*Imperata cylindrica*) grass in teak plantations**. (Dutch; English). Tectona 25: 792-803.

Author's method of combating *Imperata* grass is useful in regions without a pronounced dry monsoon and on loose soils, but for the teak region in Java it is impractical.

2085 Griffith, A.L. 1938. **An investigation into the relative merits of planting teak (*Tectona grandis*) stumps in pits and in crowbar holes in areas having a West Coast type of climate**. Indian Forest Records 3: 47-59.

The survival percentage and mean height growth shows that planting in pits gives results not different from planting in crowbar holes. The localities in which the experiments were carried out have a climate typical of the West Coast in general and an average annual rainfall varying from 60 to 120 in.

2086 Griffith, A.L. 1938. **An investigation into the best root length of stump to use when stump planting teak (*Tectona grandis*) in areas having a West Coast type of climate**. Indian Forest Records 3: 1-15.

Survival percentage and mean height growth shows that planting in pits gives results not different from planting in crowbar holes. Pitting, being much the more expensive method of preparing the soil for planting, is not therefore economically justified.

2087 Griffith, A.L. 1938. **An investigation into the best date of stump-planting teak at Begur, Dhoni and Topslip**. Indian Forest Records (n.s.), Silviculture 3(2): 46p.

Stump-planting of teak at Begur and Dhoni in the middle of April, 6-7 weeks before the break of the monsoon, gave results far superior to those of normal planting in early June. At Topslip, where pre-monsoon rains are more variable than at Begur and Dhoni, planting had to be delayed until the early part of May to minimize the risk of poor stocking.

2088 Griffith, A.L. 1939. **An investigation into the relative merits and costs of five different weeding methods in the formation of teak (*Tectona grandis*) plantations in areas having a West Coast type of climate**. Indian Forest Records (n.s.) Silviculture 4: 97-132.

Four large-scale experiments covering approximately two acres each show that of the five methods tried, weeding by scraping in 4 ft. strips is the method which gives the most beneficial results at the most reasonable cost. The weed conditions of the experiments are described in the paper.

2089 Griffith, A.L. 1939. **Investigation into the best age and diameter of stump to use when stump planting teak (*Tectona grandis*) in area having a general West Coast type of climate**. Indian Forest Records (n.s.) Silviculture 3(5): 165-194.

The study consisting of seventeen experiments conducted over a period of six years and on four centres shows that use of one or two year old stumps gives best survival and height growth. The limiting size range is put 0.3 to 0.4 inches if the stumps are 2 years old. The saving in cost of a plantation was calculated at Rs. 1.20 per acre due to use of correct size of stumps.

2090 Griffith, A.L. 1942. **Teak plantation technique**. Indian Forest Records (n.s.) Silviculture 5: 123-219.

This is a compilation of all published information on the subject supplemented by answers to a widely circulated and comprehensive questionnaire and other unpublished data available, including his own observations made during extensive tours in India and Burma. The distribution and the climatic and soil requirements of teak are described and the reasons for the general adoption of artificial regeneration reviewed.

2091 Gupta, G.N; Mohan, S; Manivachakam, P. 1986. **Effect of coir peat mulch and fertilizer application on teak establishment in dry zone**. Journal of Tropical Forestry 2(4): 204-210.

Tectona grandis seedlings were grown in plots in the Coimbatore Forest Division treated with 0, 40 or 80 kg/ha N fertilizer as urea, 0, 40 or 80 kg/ha P_2O_5 as superphosphate, with or without peat mulch. Seedling survival, soil temperature and moisture content were recorded. Mulch treatment reduced seedling mortality, increased soil moisture content and slightly reduced soil temperature.

2092 Gupta, M. 1957. **Teak in Uttar Pradesh**. Bulletin of the Uttar Pradesh Forest Department 29: 22p.

Silvicultural characters and techniques are described in detail and research to be undertaken are indicated.

2093 Hart, H.M.J. 1928. **Stem number and thinning - a preliminary study on the bast spacing and thinning method for teak forests**. Dissertation, Wageningen, The Netherlands.

2094 Hellinga, G. 1923. **Natural thinning in unthinned plantations**. (Dutch; English). Tectona 32(4/5): 290-308.

2095 Hellinga, G. 1940. **A renewed investigation on the rotation of teak (*Tectona grandis*)**. (Dutch). Tectona 33: 507-564.

Some 750 sample trees of different diameters were felled and valued according to the timber assortments they yielded. Stand values in relation to age were estimated using the price-size data thus obtained together with previously compiled yield tables and an alignment chart which indicated the diameter-class distribution of a stand of a given mean diameter. For normal stands the rotation of the maximum net income was computed at 135 years.

2096 Hellinga, G. 1956. **Efficient organization in thinning operations**. (Javanese; Dutch). Rimba Indonesia 5(9/12): 433-449.

Discusses thinning problems in Java and gives tabulated data for different species including *Tectona grandis*. Recommended thinning frequencies for *T. grandis* 14 times in 80 year rotation.

2097 Hole, R.S. 1910. **Note on the best season for coppice fellings of teak (*Tectona grandis*)**. Indian Forest Pamphlet 16 (Botany Series 1).

Describes an experiment of 1906 in Jubalpore. Trees 2-4' in basal girth selected for equal vigour and similar conditions of environment were coppiced in different months from March to September. The best results were obtained in March and September. Larger stools have more vigorous shoots.

2098 Homfray, C.K. 1934. **Technique of teak plantation work**. Proceedings of 4th Silvicultural Conference, Dehra Dun: p305.

2099 Horne, J.E.M. 1966. **Teak in Nigeria.** Nigerian Forest Information Bulletin 16: 38p.

The bulletin reviews progress of teak research in Nigeria upto 1962.

2100 Hutchins. 1909. **Teak in Brazilian East Africa**. Government Report, East African Protectorate: 79p.

2101 IUFRO. 1981. **Industrial wood production via plantations: B. Plantation systems, techniques, disease problems**. Wood production in the neotropics via plantations. IUFRO MAB USDA Forest Service. IUFRO Working Group S1.07.09, Puerto Rico, 8-12 September 1980: 137-263.

Among the papers included one paper was on spacing and thinning experiments necessary for scientific plantation management and another paper was on nutrient requirement and production potential of teak (*Tectona grandis*) plantations on alluvial sandy loams in the western llanos of Venezuela.

2102 Iyppu, A.I; Chandrasekharan, C. 1961. **Thinnings in teak**. Proceedings of the 10th Silvicultural Conference, Dehra Dun 1961 Part 2: 725-730. Forest Research Institute, India.

An account of teak plantations in Kerala and their importance in the economy are given. Thinnings and results of elite thinnings are discussed and results of thinning research carried out at Nilambur are presented. The possibility of reducing thinning cycle are pointed out.

2103 Jaski, K.C. 1909. **Elimination alang-alang in the cultivation of teak, *Ficus* and *Hevea***. (Dutch; English). Tectona 1: 145-162.

2104 Jaski, K.C. 1912. **The burning of lands to be planted**. (Dutch). Tectona 5: p846.

2105 John, R; Dattaraja, H.S; Suresh, H.S; Sukumar, R. 2002. **Density-dependence in common tree species in a tropical dry forest in Mudumalai, Southern India**. Journal of Vegetation Science 13(1): 45-56. Department of Environment and Natural Resources, Quezon City, Philippines.

Employing quadrat-based analyses, correlations of mortality, recruitment and population change with tree densities were examined.

2106 Jollye, H.C.B. 1927. **Thinning teak areas**. Indian Forester 53(9): 548-550; 52(12): 741-743.

The author opines either to cut entire multi or double leading big trees or not to cut at all and enumerates difficulties in training, felling and finances and the need for contractors to fell.

2107 Kadambi, K. 1972. **Silviculture and management of teak**. Bulletin, School of Forestry, Stephen F. Austin State University 24: 137p.

A monograph dealing with the distribution, silvicultural characteristics, natural and artificial regeneration, silvicultural systems, protection, growth and yield of *Tectona grandis* in South East Asia. Some data are also given from other tropical areas where teak is grown as an exotic. The final chapter discusses various research problems relating to the silvics, silviculture and management of teak.

2108 Kadambi, K. 1993. **Silviculture and management of teak**. 137p. Natraj Publishers, Dehra Dun.

This book presents information on the ecology, biology, silviculture and management of teak. Sections include introduction, distribution, silvicultural characteristics, natural reproduction, artificial regeneration, silvicultural systems in teak forests, protection from injury, growth and yield and research.

2109 Kale, R.B. 1962. **Teak plantations in Maharashtra State**. Maharashtra State Forest Centenary Souvenir 1847-1962: 149-153. Forest Research Institute, India.

Gives a brief description of teak forest of Maharashtra state and then deals with teak plantations under the heads - plantation sites, seed collection and treatment, teak nurseries, weeding and replacement of casu-

alities. Thinnings, plantation time table, protection, cost of raising and financial aspects of teak plantations are discussed.

2110 Kamal Naidu, M. 1973. **Use of hormones in teak plantations**. Silvicultural Conference, 6-10 December 1973, 53. Forest Research Institute, Dehra Dun.

To overcome erratic climatic effect, particularly rainfall, in Central India region, Seradix has been used to induce early rooting and early establishment to enable tiding over the erratic period. Observations on root, shoot and height growth gave satisfactory results with Seradix application when tried by pot culture with uniform soils and same size stumps.

2111 Kaufman, C.M. 1968. **Teak production and culture in Thailand**. Journal of Forestry 66(5): 396-399.

Gives an account of teak plantations, nursery techniques and plantation methods, with growth rates.

2112 Kaushik, R.C. 1956. **Change-over to elite thinnings in Nilambur**. Proceedings of the 9th Silvicultural Conference, Dehra Dun, 1956. Part 2: 16-19.

To ensure the full final yield at 70 years in the plantations, over thinning in the past has reduced to one-half, elite thinnings were introduced in 1953-54. The technique is described in detail, elites being selected in the 10th year of new plantations.

2113 Kerbert, H.J. 1908. **Experience with (Teak) planting contractors**. Tectona 1: p597.

2114 Kermode, C.W.D. 1939. **Thinning research**. Proceedings of 5th Silvicultural Conference, Dehra Dun. Forest Research Institute, Dehra Dun.

Based on old sample plot study and teak yield tables prepared thinning instructions were given in Burma. The author makes a plea, in favour of an Indo-Burma joint investigation of the effects of different types of thinnings.

2115 Kesarcodi, S.N. 1944. **Notes on the teak plantation technique**. Bombay Forest Leaflet 1.

2116 Kesarcodi, S.N. 1946. **Bombay Silvicultural Research Trienniel programme to study the rate of growth of teak coppice and to ascertain the best method of thinning**. Proceedings of 7th Silvicultural Conference, Dehra-Dun 1946, (1951): 614-616. Forest Research Institute, Dehra Dun.

2117 Khalil, M.A.K. 1943. **Advance thinning for teak plantations**. Indian Forester 69(1): 15-19.

It is stated that heavy early thinnings are inadvisable for the following reasons: teak responds well even to late thinnings, opening up of a young crop will cause the trees to become branchy, pruning is too expensive in case of teak plantations, weed growth can be kept suppressed only as long as the canopy is closed, thinnings of the first 4 years are too small to be merchantable, heavy early opening may lead to storm damage among young shallow rooted trees, drastic opening of the canopy produces an exposure of the site which may result in the conversion of good productive soil into hard unproductive laterite.

2118 Khan, M.S. 1959. **Teak in Andhra Pradesh**. Proceedings of All-India Teak Study Tour and Symposium, Dehra Dun, December 1957-January 1958: 93-106.

Teak occurs naturally in this state. These forests are worked by the method of selection cum improvement felling and coppice with reserves.

2119 Kharche, M.L. 1974. **Silviculture and management of teak (*Tectona grandis* Linn.f.) with special reference to Madhya Pradesh**. Indian Forest College, Dehra Dun: 69p.

2120 Kongsaengthai, Ch. 1964. **Evaluation of mechanical thinning and low thinning in teak plantation**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Low thinning is a suitable method more than the mechanical thinning which can be used for first thinning.

2121 Kortz, A. 1952. **Teak forest management in Java and wildlife conservation**. (Javanese). Rimba Indonesia 1(5): 230-234.

Recommends the establishment of game reserves in areas where the soil is swampy or salty and unsuited for teak.

2122 Krishnapillay, B. 2000. **Silviculture and management of teak plantations**. Unasylva 51(201): 14-21.

This article looks at the potential of teak as a plantation species, focusing on management strategies, ecological requirements, growth performance, wood quality and availability of planting materials, with examples drawn from the Malaysian experience. It enumerates some topics of current research likely to contribute to teak plantation development.

2123 Krishnaswamy, V.S. 1953. **Thinning research in India**. Indian Forester 79(11): 581-589.

A review of current projects including thinning of teak, *Pinus longifolia*, *Shorea robusta*, *Cryptomeria japonica* and *Cedrus deodara*. A tree classification for use in thinning studies is given.

2124 Krishnaswamy, V.S. 1959. **A note on elite thinning in teak plantations in Madras state**. Proceedings of All-India Teak Study Tour and Symposium, December 1957-January 1958: 169-171. Forest Research Institute, Dehra Dun.

Thinnings carried out are described and the results are analysed. Incorrect thinnings result in open crops. A new method of elite thinning was described. The method of selection of elites and thinning were discussed. Since elites put on rapid girth increment rotation can be reduced from 70 years to 45 years.

2125 Krishnaswamy, V.S. 1960. **A description and discussion on the new method of thinning teak plantations in the Madras State**. Proceedings of the 9th Silvicultural Conference, Dehra Dun, 1956 Part 2: 31-32.

Another account with diagrams illustrating the selection of stems at each thinning.

2126 Kushalappa, C.M. 1951. **Teak in Coorg**. Madras Forest College Magazine 27(3): 109-121.

Notes on teak is given under the heads elevation, rainfall, soil and climate, occurrence of teak, how teak is grown and the desirability of growing mixed plantations, weeding and tending, thinnings, fire protection, interference by fast growing inferior species and seed origin.

2127 Kusuma Suebsaeng. 1986. **Analysis of optimum forest rotation and its social economic implications: A case study of teak in Thailand**. Kasetsart University, Bangkok: 92 leaves.

The results of optimum rotation in different site indices are given. Criteria for financial investment for teak were harvested at the optimum rotation age were benefit-cost ratio, net present value and rate of return.

2128 Lal, A.B. 1942. **Advance thinning for teak plantations**. Indian Forester 68: 430-435.

The disadvantages of both ordinary and advance thinning are discussed, and an attempt is made to justify preferential use of the latter method.

2129 Lal, A.B. 1943. **Advance thinning for teak plantations**. Indian Forester 69: 170-173.

Six points are stressed of the advantage of advance thinning in plantations.

2130 Lamb, A.F.A. 1970. **Impressions of plantation forestry in parts of India and Ceylon**. Commonwealth Forestry Institute, Oxford.

2131 Lampe, M. 1940. **Cultivated strips as fire barriers in Indramayu**. (Dutch). Tectona 33: 488-489.

The method of protection described consists teak planting on burned and cleared strips of at least 200 m. width on the windward side of last year's plantations. Owing to complete absence of litter and weeds the newly planted strip is practically immune from fire and thus protects the stands on the lee.

2132 Lande, M.L. 1987. **Studies of the management system for long rotations of man-made forests. Comparative considerations of management systems for teak plantations and cedar plantations of the Yoshino District**. (Japanese). Research Bulletins of the College Experiment Forests, Hokkaido University 44(3): 955-1017.

The management of *Tectona grandis* plantations in Indonesia is described and compared with that of intensively managed *Cryptomeria japonica* plantations near Kawakami village in Japan. Recommended planting densities and thinning regimes are given for improving teak production and quality in Indonesia.

2133 Lapongan, J. 2000. **Status of teak plantation management in Sabah**. Proceedings of the Seminar on High Value Timber Species for Plantation Establishment Teak and Mahoganies, Sabah, 1-2 December 1998. JIRCAS Working Report 16: 19-25. H.H. Chan; K. Matsumoto, Eds.

This paper briefly reports the status of teak plantations in Sabah, Malaysia, which covers the growth performance of teak in various localities, nursery techniques, planting methods and other silvicultural practices including intercropping with oil palm or cocoa. Teak is recommended for consideration for long-term plantation programmes, due to its remarkable growth performance and the high value of wood products.

2134 Larsen, C.S. 1956. **Teak**. Proceedings of the 12th IUFRO Congress, Oxford, 1956 56/22/1-A (56/5/3057): 3p.

In view of the great utilization and extensive planting of this species, the need for research is stressed and experience of Burma, Trinidad etc, are highlighted.

2135 Larson, B.C; Zaman, M.N. 1985. **Thinning guidelines for teak**. Malaysian Forester 48(3/4): 288-297.

The relation between d.b.h. and crown diameter was investigated in two plantations of 9 and 14 yr old at Cox's Bazar, Bangladesh. The regression of crown diameter on d.b.h. was linear, with a negative intercept probably due to relatively low site quality. Stand densities at full stocking are tabulated with extrapolation up to 22 inches d.b.h. Stem numbers are plotted against mean d.b.h. for various degrees of crown disengagement.

2136 Laurie, M.V. 1934. **Early stump planting**. Indian Forester 60(9): 609-612.

The author challenges some contentions with experimental data and concludes great advantage in height growth combined with a good percentage of survivals of early stump planting in moisture areas and also demonstrated the hardness of such stumps to periods of drought following the planting.

2137 Laurie, M.V. 1937. **The beginning of teak plantations in India**. Indian Forester 63(3): 151-154.

Tracing out the history of earliest teak plantations in India and also problems encountered in germinating teak seed, the enterprising work of Mr. Chattu Menon during 1843 to 1862 period was discussed and Nilambur plantations of 1846 (Conolly's plantations) was illustrated. Totally 150 acres was raised between 1846-1865.

2138 Laurie, M.V. 1938. **A rough guide to thinning teak based on average spacing for a given mean diameter**. Indian Forester 64: 397-398.

The author suggests that the minimum espacement for irregular forests of teak might be found by adding three to the diameter of the tree in inches and thinning to the same number of feet around it.

2139 Laurie, M.V. 1939. **The most paying rotation in Indian Forestry**. Indian Forester 65(7).

2140 Laurie, M.V. 1941. **Teak plantation technique**. Proceedings of the 5th silvicultural Conference, Dehra Dun, 1941: 375-381.

Discussed the selection of sites, method of stocking, stump planting, nursery work, weeding, taungya, spacing and early thinning and timber quality.

2141 Laurie, M.V. 1941. **The problem of the pure teak plantation**. Proceedings of the 5th silvicultural Conference, Dehra Dun, 1939: 123-132.

Advantages and disadvantages of pure teak plantations and matters required for further investigation are summarised.

2142 Laurie, M.V; Griffith, A.L. 1942. **The problem of the pure teak plantation**. Indian Forest Records (n.s.) Silviculture 5: 121p.

Information from various parts of India, Burma, Java and from recent publications regarding the disadvantages of pure teak plantation is summarised.

2143 Laurie, M.V; Griffith, A.L. 1943. **The problem of pure teak plantation**. Indian Forester 69(1): 33-34.

Information received from various parts of India, Burma, Java and from recent publications on the disadvantages of pure teak plantations is summarised.

2144 Leete, F.A. 1911. **Teak plantations in Burma**. Indian Forest Bulletin 2: 1-21.

Data available upto 1909 with regard to the growing stock in teak plantation in Burma are presented.

2145 Lowe, R.G. 1967. **Competition and thinning studies in Nigeria**. 9th Commonwealth Forestry Conference, New Delhi.

Describes the methods of analysis tried and the lay-out of experiments in *Nauclea diderrichii*, *Tectona grandis* and *Terminalia ivorensis*.

2146 Lowe, R.G. 1968. **Thinning teak**. Bulletin Nigerian Forest Department 28: 2-4.

2147 Lowe, R.G. 1976. **Teak (*Tectona grandis* Linn.f.) thinning experiment in Nigeria**. Commonwealth Forestry Review 55(165): 189-202.

Pattern analysis of basal area increment showed that even for the heaviest thinning, the fastest growing individuals, both before and after treatment, tended to remain the fastest.

2148 Lugt, C.S. 1908. ***Tectona grandis* planting in forest district Bodjonegoro (Java) under contract without simultaneous cultivation of rice**. Tectona 1: 546-556.

2149 Lushington, A.W. 1907. **Is a period of rest and rotation of crops wanted for teak reproduction?** Indian Forester 33(9): 409-415.

In Nallamalais forest of Kurnool, clear fellings in 1901 resulted in plentiful natural regeneration of teak. Teak was abundant in these forests, whereas in eighties and nineties a totally different forest type arose by which teak is temporarily ousted and from 1901 onwards, when this forest was clearcut, teak sprang up in abundance from seed which must have laid dormant in the ground for many years.

2150 Mahapol, S. 1954. **Teak in Thailand**. Royal Forest Department, Bangkok Report R.16; FAO Asia Pacific Forestry Commission FAO/APFC 55/54: 31p.

Covers ecology, silviculture, injuries and protection, yield and increment.

2151 Maitland, V.K. 1927. **Thinning teak areas**. Indian Forester 53(7): 425-427.

Thinning teak areas and singling out double or multi stems, the author advocates the desirability and profitability of forest of single straight stems.

2152 Maldonado, E.D; Boone, R.S. 1968. **Shaping and planning characteristics of plantation grown mahogany and teak**. Institute of Tropical Forestry, Rio Piedras, United States Forest Service Research Paper ITF-7: 22p.

Mahogany and teak are proved superior in shaping and planing properties to all other woods tested. It is found that plantation grown timbers including *T. grandis* yielded wood as good as the imported forest-grown material in shaping.

2153 Marigoudra, R.M; Madiwalar, S.L. 2004. **Effect of planting methods and fertilizer levels on initial growth and foliar nutrient contents of teak**. Karnataka Journal of Agricultural Sciences 17(1): 72-75.

A field experiment was conducted to study the effect of planting methods and fertilizer levels on the initial growth increment of teak planted on bunds of upland paddy field in Mundgod, Karnataka, India.

2154 Marshall, R.C. 1929. **Growing teak in Trinidad**. Tropical Woods 19(1/3).

Teak was first introduced in Trinidad in 1913. 15-16 years old plantations have an average height of 70 ft. and m.a.i. was 126 cu.ft./acre based on sample plot studies. Notes on nursery and planting methods of teak, care of young plantations were also given.

2155 Marshall, R.C. 1930. **Silvicultural notes on the more important timber trees of Trinidad and Tobago with information on the formation of woods**. Trinidad Government Printing Office.

Tectona grandis is one of the many species included.

2156 Marshall, R.C. 1939. **Silviculture of the trees of Trinidad and Tobago, British West Indies**. Oxford University Press, London: 189-192.

Tracing its introduction to 1913, distribution, habitat, germination, seedling and silvicultural characteristics, artificial regeneration methods, nursery, techniques, and later tending, thinning etc., are discussed. Some statistical data are presented and utilization aspect is also discussed.

2157 Marten, K.D; Thomson, B.R. 1980. **The silvics of species**. Forestry Division, Solomon Islands, Research Reports S-1-12-80: 119p.

A summary of the performance of the major plantation species including teak in divisional trials plots, which have shown promise in trials and are already used in the Solomons afforestation programme.

2158 Mathur, C.M. 1961. **Rehabilitation of degraded dry teak forests of Rajasthan**. Proceedings of 10th Silvicultural Conference, Dehra Dun, 1961, Part 2. Forest Research Institute, Dehra Dun.

A description of degraded teak forests and the various measures taken for their rehabilitation are given and results of working them are indicated.

2159 Matos Gonzalez, E. 1972. **Description and analysis of growth of the teak (*Tectona grandis*) plantation at Itabo Experimental Station, Marti, Matanzas**. Baracoa 2(2): 22-31.

The data show that on the infertile clay soil found at Itabo growth is good in the early stages but decreases later because the roots are unable to penetrate the dense clay subsoil. A subsoiling treatment and application of fertilizer are recommended, together with further thinning and retention of part of the stand for experimental purposes.

2160 Mensbruge, G de la. 1956. **Enrichment of the Upper Ivory Coast savanna - introduction of teak**. (French). Proceedings of the 4th World Forestry Congress, Dehra Dun, 1954: 312-321.

The teak plantations described are protected and are thinned every 5 years from 6-8 years onwards. The objective is to introduce indigenous species under the teak and restore the original forest cover.

2161 Metcalfe, J. 2002. **Strategic feeding, vigorous seedlings, healthy trees**. Partners in Research for Development 15: 23-30.

Results are presented from projects which have investigated the nutritional aspects of forest plantations including teak in the western Pacific and north Queensland, Australia. The project focused on the early growth of tree seedlings in nurseries, techniques for determining nutritional needs and the use of slow release fertilizers and coir potting mixtures. Another project examined the nutrient requirements of plantation timber trees, the development of efficient fertilizer strategies and the effect of tree harvesting on the nutrient capital of a site.

2162 Minchin, A.A.F. 1929. **The problem of pure teak plantation**. Proceedings of the 3rd Silvicultural Conference, Dehra Dun: 83-87.

2163 Mirchandani, T.K. 1941. **Treatment of teak plantations**. Indian Forester 67: 399-402.

An example of a proposed method of obtaining mixed stands is outlined on the basis of a 135-year rotation and initial spacing of teak at 6 X 6 ft.

2164 Mohanty, A.P. 1956. **Progress of teak plantation in Angul**. Indian Forester 82(4): 197-202.

Planting of teak began in this division of Bihar and Orissa in 1886. Described the methods of planting and treatment of the plantations. Some growth data are also given.

2165 Moni, A.S. 1951. **Forests (plantations) Pure v/s mixed with reference to teak**. Madras Forest College Magazine 27(3): 121-127.

Discusses the relative merits and demerits of raising pure and mixed plantations.

2166 Moni, G. 1959. **Short history of the Konni teak plantations**. Proceedings of All-India Teak Study Tour and Symposium December 1957-January 1958, Dehra Dun: 164-165.

Gives a short history of teak forests and plantations at Konni which started with an espacement of 6'x6' in 1870 to taungya plantations in 1920. Describes the technique of raising plantations. Eupatorium spp. a weed is suppressing teak and also effected by water blister diseases.

2167 Moore, D. 1962. **Utilization of teak thinnings in Trinidad and Tobago**. Caribbean Forester 23(2): 82-86.

Teak was introduced into Trinidad in 1913 and a factory producing fence posts, and lumber from small size teak thinnings which has proved profitable is now in operation. The factory also disposes slash from forest, thus removing fire-hazard, creates rural employment and publicises qualities of locally grown teak.

2168 Mueller Darss, H. 1973. **An ergonomic case study to determine a fair day's work: A study of thinning in a teak plantation in a tropical climate**. Forstarchiv 44(11): 243-244.

Describes a study of performance, pulse frequencies and energy consumption of one worker during thinning operations in a 10-year-old teak plantation on the S. slope of the Venezuelan Andes in a tropical climate.

2169 Mueller Darss, H. 1973. **Ergonomic case study to determine labour performance: A study of thinning in a teak plantation in a tropical climate**. Boletin, Instituto Forestal Latino Americano 44-45: 51-55.

2170 Murillo, O. 1991. **Methodology for quality control in forest plantations**. Tecnologia en Marcha 11(1): 19-29.

The paper describes the development of criteria and attributes for evaluating individual trees of different species including *Tectona grandis* for fuelwood, saw timber or pulp.

2171 Neumann, A.J. 1987. ***Tectona grandis* spacing/thinning trials - interim results**. Forest Division, Solomon Islands, Forestry Note 23-6-87: 6p.

It is found that height increased with increased stocking. The regression of merchantable height on stocking indicated an increase of 1.1 m in height with an increase of

400 stems/ha. An equation is given for the thinning ratio.

2172 Noltee, A.C. 1923. **About plantations in the teak forest region**. (Dutch; English). Tectona 16(8/9): 667-681; Korte Meded Proefsta Boschw 6: 1-28.

Described the clearfelling, slash burning, preparation of planting site, planting espacement and use of soil cover etc. of the teak plantations of Java. Hints are given on collection and storing of seed and nursery methods and introductions of mixtures. The past treatment and management of old forests are discussed. Principles for clear cutting and replanting are outlined.

2173 Noor, H.M. 2002. **The growth response of a 20-year-old teak (*Tectona grandis* Linn.f.) stand to thinning intensity**. Malaysian Forester 65(4): 198-209.

A thinning experiment was conducted in a 20 year old stand of teak and found that the thinning treatments improved the diameter, basal area and volume growth of teak trees. It is found that 40 percent thinning gave the best basal area and volume growth.

2174 Nwoboshi, L.C. 1971. **A preliminary report on the application of row, electic and basal area thinnings on an 8 year old teak stand**. Department of Forestry, Ibadan University, Research Notes 1(1): 1-4.

Six thinning treatments were applied in a Nigerian plantation of *Tectona grandis* combined low and crown thinning, row thinnings in which every third or every second row was removed, two intensities of electic thinning in which all trees, dead or alive/along a row were compared in progressive groups of four or five and the best tree in each group was retained and unthinned control. Data are given to show the effect of thinning treatment on the quality of the stand.

2175 Nynetr, M. 1970. **Thinnings in teak plantation**. (Thai). Vanasarn 28(1): 33-45.

Five methods of thinning followed in Thailand are described and recommendations are made on thinning cycles to be adopted.

2176 Oever, H.Ten. 1909. **Miscellancy from thinning practice and teak plantations**. Tectona 1: 440-444.

2177 Oever, H.Ten. 1918. **Notes on *Tectona grandis* in Bantam**. Tectona 2: 283-289.

2178 Ohn Maung. 1968. **Control of thinning of teak plantations in Burma**. Union Burma Journal of Life Science 1(2): 194-199.

A close linear correlation is shown to exist between the logarithm of number of stems per acre and the logarithm of average diameter, which can be used to calculate the stem number as given in the yield tables for a given average diameter.

2179 Ola-Adams, B.A. 1990. **Influence of spacing on growth and yield of *Tectona grandis* Linn.f. (teak) and *Terminalia superba* Engl. & Diels (afara)**. Journal of Tropical Forest Science 2(3): 180-186.

The effects of spacing in relation to growth and wood production in 18-yr-old *Tectona grandis* was investigated. The results showed that percentage survival, diameter at breast height and specific gravity increased with increasing spacing while merchantable height, stem volume and basal area decreased with increasing spacing.

2180 Ola-Adams, B.A. 1993. **Effects of spacing on biomass distribution and nutrient content of *Tectona grandis* Linn.f. (teak) and *Terminalia superba* Engl. & Diels. (afara) in south-western Nigeria**. Forest Ecology and Management 58(3/4): 299-319.

The effects of four different spacings on biomass and nutrient distribution were studied. There were significant differences between spacings in dry weights of small branches and big roots. No consistent pattern of total nutrient content with spacing is reported in the case of teak.

2181 Ola-Adams, B.A; Egunjobi, J.K. 1992. **Effects of spacing on litterfall and nutrient contents in stands of *Tectona grandis* Linn.f. and *Terminalia superba* Engl. and Diels**. African Journal of Ecology 30(1): 18-32.

The rate of litterfall was high in the dry season in *Tectona grandis*. There were no significant differences between spacings in either species in relation to amount of litterfall or nutrient content of litterfall.

2182 Patel, R.I. 1967. **Note on thinning in coppice crop of teak**. Proceedings of the 11th Silvicultural Conference, Dehra Dun, 1967, Part I, Item h(1). Forest Research Institute, Dehra Dun.

The dry and very dry teak forests of Madhya Pradesh, Gujarat, Rajasthan and Maharashtra were mainly managed under coppice crop. Here stressed the need for further studies for finalising thinning research.

2183 Perera, W.R.H. 1962. **The development of forest plantations in Ceylon since the seventeenth century**. Ceylon Forester 5(3): 142-151.

Reports that teak was first introduced in Ceylon in 1680.

2184 Perera, W.R.H. 1975. **Teak first thinnings for paper pulp**. Sri Lanka Forester 12(1): 50-51.

First thinnings of *Tectona grandis* were tested for the kraft pulp process and the semi-chemical pulp process and five grades of kraft paper were produced.

2185 Perez, L.D; Viquez, E; Kanninen, M. 2003. **Preliminary pruning programme for *Tectona grandis* plantations in Costa Rica**. Journal of Tropical Forest Science 15(4): 557-569.

An investigation was carried out to study the structure and composition of the crown biomass to develop a pruning programme for teak in Costa Rica. The results indicate that the first pruning should be carried out when trees reach a height of 4 to 5 m and the second pruning should be done when the stand reaches 9 to 10 m of height.

2186 Phrombupha, A.S; Indrachanjra, P.K. 1967. **Study on the effect of different intensities of thinnings on the increment of teak in plantation**. Proceedings of the First Silvicultural Seminar, Royal Forest Department, Ministry of Agriculture, Bangkok: 83-87.

Significant difference is observed in different intensities of thinning control, 50 percent, 60 percent, 70 percent and 80 percent thinning of basal area.

2187 Pieters, A; Maerschalk, J de. 1973. **A teak plantation in the Kinshasa Region (Zaire)**. Sylva Gandavensis 40: 42p.

Discussed soils, vegetation, planting methods, initial spacing, treatment, structure, stem form and quality, increment, standing volume, etc of the plantation. Silvicultural recommendations are made based on the observations.

2188 Pillai, R.D. 1933. **Stump transplanting of teak in Travancore**. Indian Forester 59(1): p119.

Nursery methods, stump preparation and planting are described in detail.

2189 Pillai, R.D. 1933. **Stump transplanting of teak in Travancore**. Indian Forester 59(4): 259-261.

Quoting instructions of Mr. Bourdillon, traces the stump planting in the state to 42 years ago in 1890-91 and states it was the universal practice for the last 30 years in the state.

2190 Piotto, D; Montagnini, F; Kanninen, M; Ugalde Arias, L.A; Viquez, E. 2002. **Forest plantations in Costa Rica and Nicaragua: Species performance and farmers preferences**. (Spanish). Revista Forestal Centroamericana 38: 59-66.

This study took place in commercial plantations including *Tectona grandis* in 112 forest production farms in Sarapiqui, Costa Rica, and Carazo, Nicaragua. An inventory of forest plantations was conducted. The evaluated variables were tree survival, canopy gap, total height, form and health.

2191 Plasschaert, E.K. 1911. **More intensive teak cultivation methods**. (Dutch; English). Tectona 4: 609-614.

2192 Pongsopha, Ch. 1962. **Comparison of teak growth resulting from different degrees of thinning**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Thinnings carried out with 50 percent, 60 percent, 70 percent and 80 percent, compared with normal thinnings. The basal areas recorded for various grades of thinnings shows control differed only from 80 percent thinning significantly in height growth, which increased after thinning. Heavy thinning is considered desirable for teak.

2193 Porapakkharm, Ch. 1963. **A comparison of growth in planting teak stumps with root and rootless stumps**. (Thai). Thesis. Kasetsart University, Bangkok.

It is observed that growth of stumps with root is better than that of without root and also have higher survival percentage.

2194 Prakong Intrachandra. 1975. **Efficiency comparison between mechanized and hand weeding at Ban Dan Lan Hoy teak plantation, Sukhothai province**. Forest Research Bulletin, Faculty of Forestry, Kasetsart University, Thailand 32: 25p.

A comparison of costs of mechanized and hand weeding in a teak plantation is made and showed that unless at least 1800 rai were to be weeded annually, hand weeding was preferable to mechanized weeding.

2195 Prasad, R. 1973. **Limitation of formula thinning in teak forest of M.P**. Forestry Confer-

ence (Silvicultural Conference) 6-10 December 1973, 81. Forest Research Institution, Dehra Dun.

It suggests that in early stage at least more stems per unit area be retained and the crop can be opened up more at a later stage for higher diameter increment. A modified formula is suggested using girth instead of diameter.

2196 Prasad, R. 1987. **Technological planning *vis-a-vis* plantations: A case study of Kesla Project, Hoshangabad**. Journal of Tropical Forestry 3(3): 198-206.

The causes of the failure of the teak or teak and bamboo plantations established at Churna in the Hoshangabad Forest Division (Kesla), Madhya Pradesh are discussed. Ways of improving the site for teak and better planting techniques are discussed.

2197 Qureshi, I.M. 1956. **Problems of thinning in coppice teak crops**. Proceedings of the 9th Silvicultural Conference, Dehra Dun, 1956. Part 2: 1-2.

Treatments, lay-out and experimental design are discussed.

2198 Rahman, A; Mustanoja, K.J. 1978. **Optimum rotations for forest plantations in Bangladesh**. Bano Biggyan Patrika 7(1/2): 48-59.

It is a review of the important published models of rotations, which are classified as service rotations, physical rotations and financial rotations. A case study is given to illustrate the differences in rotation prescribed by the models based on data for teak from Bangladesh.

2199 Rajarajan, A; Surendran, C; Balamurugan, J. 2001. **Root activity pattern of *Tectona grandis* under two different espacements**. Madras Agricultural Journal 88(7/9): 517-519.

Results of a study conducted to investigate the root activity of teak under different spacings and various soil depths using the radio tracer 32p orthophosphoric acid are presented.

2200 Ram, B.S. 1939. **Thinning research**. Proceedings of the 5th Silvicultural Conference, Dehra Dun: p199. Forest Research Institute, Dehra Dun.

Reports on replicated and unreplicated experimental plots laid out in Central Provinces, Coorg and Madras states.

2201 Ram, B.S. 1946. **The price-age gradient of Bori teak**. Indian Forest Bulletin (n.s.) Silviculture 132: 15p.

A study was undertaken for determining the most profitable rotation. The analysis of the data recorded shows that the net price per tree varies directly with age that the price per cu. ft. continues to rise up to the age of 120 years. The study indicates that the rotation of highest net income lies somewhere beyond the age of 120 years.

2202 Ranjit Singh, T. 1907. **An experiment on growing teak (*Tectona grandis*) by live teak stakes in the Narasingarh, State Central India**. Indian Forester 33(6): 283-284.

Performance of live stakes of teak planted in two different types of soils of Narasingarh, Madhya Pradesh is investigated.

2203 Raunio, A.L. 1975. **Clean weeding improves growth of teak in Longuza**. Silviculture Research Station, Tanzania, Technical Note 25: 6p.

2204 Robertson, B. 2002. **Growing teak in the top end of the Northern Territory (*Tectona grandis*)**. Agnote Northern Territory of Australia G26: 5p. Department of Primary Industries and Fisheries, Northern Territory of Australia, Darwin, Australia.

The germination, planting material, soil requirements, site preparation and planting, thinning, uses, seasoning, durability, working qualities and pests and diseases of teak in Northern Territory, Australia are presented.

2205 Rojas, O; Murillo, O. 2000. **Quality of teak plantations in the Nicoya Peninsula, Costa Rica**. (Spanish). Agronomia Costarricense 24(2): 65-75.

Twenty five 6-year old teak reforestation projects in Nicoya and Hojancha counties, Nicoya Peninsula, Guanacaste, Costa Rica were evaluated. Results indicate that more than 48 percent of the plantations in this region show an acceptable quality.

2206 Roosendael, J van. 1928. **Thinning of Tectona plantations in Java**. Tectona 21: 803-840.

2207 Ross, P. 1958. **Herbicide control of coppicing in teak**. Botanical Gazette 120(1): 59-61.

Presents the results of experiments on the use of various growth-regulators to prevent coppicing of teak stumps after thinning in plantations in Trinidad.

2208 Roychoudhury, K.C. 1959. **Teak plantations of West Bengal**. Proceedings of All-India Teak Study Tour and Symposium, December 1957-January 1958, Dehra Dun: 176-178.

Describes the present day technique of raising teak plantations in West Bengal. The problems confronting raising teak plantations have also discussed.

2209 Sagreiya, K.P. 1946. **Single stem silviculture**. Indian Forester 72(11): 515-526.

A method of tending irregular teak crops of coppice origin is described. The best of the dominant stems are selected for retention and given the optimum growing space by felling the inferior dominant and dominated stems interfering with the crowns.

2210 Sagreiya, K.P. 1947. **Single stem silviculture**. Indian Forester 73(7): 323-329 .

Describes how the normal N/D curve could be used as a guide to thin teak plantations and to measure and control the intensity of thinning.

2211 Sagreiya, K.P. 1952. **Single stem silviculture**. Indian Forester 78(4): 199-205.

Advocating a method of thinning irregular crops of teak.

2212 Sagreiya, K.P. 1955. **Single stem silviculture**. Indian Forester 81(12): 753-764.

Suggests the use of the N/D correlation for teak of coppice origin in the same manner as the N/V correlation has been used by O'Connor for solving a variety of specific problems connected with thinning regimes.

2213 Sagreiya, K.P. 1956. **Practicable thinnings (in naturally regenerated young crops of teak)**. Indian Forester 82(11): 553-561.

The paper describes a method of thinning irregular young crops of teak, of coppice, seedling-coppice and seedling origin. It prescribes selection of the best stems and then giving each of them the optimum growing space, according to the formula D = 1.5(d + 4) where D is the diameter of the growing space in feet, and d the diameter of the stem in inches.

2214 Sandrasegaran, K. 1966. **Optimum planting distances and crop densities of the ten exotic species in Malaya utilising triangular spacing based on a consideration of crown diameter to stem diameter relationship**. Forest Research Institute, Kepong, Research Pamphlet 51: 44p.

Crown diameter relationship to stem diameter is discussed and the range of kd/d relationship considered for ten exotic species including *Tectona grandis*. Tables are provided showing optimum planting distances and the corresponding crop densities and basal area.

2215 Sarlin, P. 1966. **The first thinning in teak plantations**. (French). Bois et Forests des Tropiques 108: 5-20.

It is showed that increment was markedly depressed before thinning, but was resumed later, especially by the larger trees. The merits of several methods of determining the best age for thinning are examined, viz. soil analysis before planting, stem analysis, measurement of relative illumination and empirical observation of the stand.

2216 Scholten, F.K. 1932. **Remarks on water cuttings and branch formation in the young plantation teak**. Tectona 25: 808-809.

2217 Sekar, T. 2000. **Twentieth century milestones in Tamil Nadu forestry**. Indian Forester 126(1): 3-8.

The salient aspects are described of four noteworthy achievements in the field of production forestry in Tamil Nadu during the 20th century. These include silvicultural practices relating to river fringe and canal bank plantations of teak.

2218 Sen Gupta, H. 1934. **Early stump planting of teak**. Indian Forester 60(3): 238-239; 171; 609.

Details of the methods of stump planting are discussed and compared with those of Devekar.

2219 Sen Gupta, J.N. 1936. **Best date for premonsoon planting of teak stumps**. Indian Forester 62(7): 434-435.

Suggests best and safest period for South West monsoon areas is from mid April to mid May. Burma experience of premonsoon stump planting with banked up soil around stumps gave better height growth and reduces casualities.

2220 Seth, S.K. 1957. **Report from India on silviculture and management of teak. I. Teak races and seed origins. II. Teak soils**. FAO Teak Sub-Commission, Bandung FAO/TSC-57/7: 21p.

A review of the literature covering India, Burma, Indonesia and Pakistan, and dis-

cussing structure, nutrients and water relations, geology, pH and soil deterioration and soil conservation in teak plantations.

2221 Seth, V.K. 1958. **Thinnings in young teak coppice forests of the Betul division**. Indian Forester 84(9): 568-570.

Describes the method of thinning used of single stem silviculture.

2222 Shirley, G.S. 1928. **Effect of neglect of thinnings in teak plantations**. Indian Forester 54(3): 170-172.

The author reports that neglect and delay of thinnings results in congestion of crowns, poor undergrowth, erosion and slow girth increment and deficient volume.

2223 Shirley, G.S. 1928. **Note on the natural thinnings in young teak plantations**. Indian Forester 55(4): 225-227.

From sample plot studies of thinned and unthinned teak plantations of Kaing reserve, Rjinniana division, Burma, the author gives figures and data of number of stumps and casualities. Data of growth and increment for dominant trees is given for thinned and unthinned plantations.

2224 Sibomana, G; Makonda, F.B.S; Malimbwi, R.E; Chamshama, S.A.O; Iddi, S. 1997. **Effect of spacing on performance of teak at Longuza, Tanga, Tanzania**. Journal of Tropical Forest Science 10(2): 176-187.

Results showed that dbh, number of branches, total height, basal area, basic density and some strength properties were significantly affected by spacing. The diameter at breast height and number of branches increased with increasing spacing, while basal area decreased.

2225 Singh, B. 1962. **Degraded teak forests of Rajasthan and their rehabilitation**. Indian Forester 88(4): 285-288.

Describes operations carried out which include cutting back the degraded crop, tending the subsequent coppice regrowth and planting up gaps.

2226 Singh, P. 1948. **Single stem silviculture and the conception and classification of thinnings**. Indian Forester 74(2): 73-77.

A criticism of Sagreiya's proposed system for thinning teak, in the light of the writer's tree-classification system.

2227 Sirito, N.B; Ole Meiludie, R.E.L. 1991. **Productivity and costs for different cutting methods in thinning a teak plantation**. Faculty of Forestry, Sokoine University of Agriculture 48. Morogoro, Tanzania.

A study was carried out to evaluate production rates and costs for five commonly used cutting methods in thinning. Detailed time studies on two-man crosscut saw, one-man crosscut saw, axe and chainsaw cutting operations were undertaken at the Mtibwa Forest Project in a single stand where selective thinning operations were underway. Time study and production data were analysed to develop statistical equations that were used to estimate productive cutting time per tree for each of the methods. Production rate equations and estimates of unit cutting costs were provided.

2228 Sisukho, M. 1977. **Thinning technique in teak plantation**. (Thai). Proceedings of the National Forestry Conference, Bangkok, 16 December 1976. Ministry of Agriculture and Cooperatives, Bangkok.

2229 Snepvangers, F.W. 1925. **The age of natural teak forests**. Tectona 15: 602-605.

2230 Snepvangers, F.W. 1930. **Notes on *Tectona grandis***. Tectona 23: 119-126.

2231 Snepvangers, P.W. 1929. **Thinning of teak forests**. Tectona 22: 294-297.

2232 Soeters, K. 1915. **Rotation in teak forests**. Tectona 8: 443-452.

2233 Srivastava, S.S. 1959. **Management of teak forests under coppice system in former Madhya Pradesh *vis-a-vis* natural regeneration of teak**. Proceedings of All-India Teak Study Tour and Symposium, Dehra Dun, December 1957-January 1958: 143-147.

After giving a short description of teak forest of Madhya Pradesh and their history, the author suggests detailed treatments for obtaining natural reproduction of teak after working the forest under coppice with reserve system.

2234 Stebbing, E.P. 1900. **Note on the Myautaung teak plantation in the Arracan District, Burma**. Indian Forester 26(4): 163-167.

Detailed notes on the present condition, situation, method of raising are given and recommendations are made for future treatment of these plantations.

2235 Sudarmo, M.K. 1957. **Thinning studies**. FAO/Teak Sub-Commission, Bandung FAO/TSC-57/27: 2p. FAO, Rome.

Describes Indonesian practice, in which thinning from below and the use of Hart's stand density index are reported to be prevalent.

2236 Suraphapmaitri, S. 1986. **Yield-density effects teak plantation**. Kasetsart University, Bangkok: 66 leaves.

The result showed that diameter class as ground level and total height of each stand density were inversely correlated to the stand density as stand age increased. Values of competition-index in various components indicated the increasing trend with stand density and stand age and differed among each component of trees. Growth coefficient of each fraction increased following to stand age.

2237 Tandon, M.N. 1972. **Teak plantation near Marripakalu seen from a height of 500 feet East Godavari, A.P**. Indian Forester 98(3).

2238 Teak Improvement Centre, Ngao. 1974. **Progress report-July 1973-June 1974**. Progress Report October 1974: 12p. Teak Improvement Centre, Ngao.

The Thai-Danish co-operation ends on 25-1-1975. It includes, provenance studies both in the nursery and field. The stump budding technique was illustrated and explained, with promising results of 98 percent. The work undertaken during the year, on seed orchards and seed source areas is explained. Pollination studies include, results of different pollination methods between clones and also with reference to the percentage of fruit developed and their germination in nursery. Silvicultural trials include spacing, seeding, pruning and thinning trials, nursery and seed investigations, seed storage studies, manuring and fertilizer trials, stump storage trials etc. A final evaluation and recommendations were made of the project for the period 1965-1975 to DANIDA.

2239 Thaiutsa, B; Kajornsrichon, S; Tiyanon, S. 1992. **Research of teak plantation**. Proceedings of the Seminar on 50 Anniversary of Hyay-Tak Teak plantation, Bangkok, 5-8 August 1992.

Huay-Tak teak plantation is the center of field researches in all aspect of teak establishment. Research at this plantation include seed collection, seed storage, seed germination, provenance trials, stump storage, spacing trials, site quality index, growth performance, pest damage, thinning, rotation and economic returns.

2240 Thomson, B.R; Thomson, B.R. 1980. **Spacing strategies for plantations in the Western Solomons**. Forestry Division, Solomon Islands, Forest Research Note 7-80: 7p.

The causes of the poor performance of line-planted stands on logged areas in the Solomons are discussed. Suitable spacing and thinning strategies are discussed for different sites and species including *Tectona grandis*.

2241 Tiwari, S.D.N. 1966. **Some observations on teak plantations**. Indian Forester 92(12): 745-748.

Establishment of large scale nurseries, control of sprouting before conversion to root shoot cutting, rejection of slow growing plants, use of fertilisers and adoption of a shorter planting distance are some of the measures suggested by the author to raise teak plantations on a large scale at minimum cost.

2242 Trevor, C.G. 1926. **Thinning teak areas**. Indian Forester 52: p677.

Emphasizes the need for early thinnings and pruning unsound branches upto 6" diameter to improve yield.

2243 U Kyaw Zan. 1953. **Note on the effect of 70 years treatment under selection system and fire protection in the Kangyi Reserve**. Burmese Forester 3(1): 11-18.

As because of forest received regular treatment under working plan prescriptions from 1870 to 1941 without a break, its value and revenue were greatly increased. The two most valuable species were *Tectona grandis* and *Xylia dolabriformis*.

2244 Vahid, S.A. 1927. **Thinning teak areas**. Indian Forester 53(12): 741-743.

Practical difficulties in removal of double stems and pleads for further investigations on the problem and its effects.

2245 Venkataramany, P. 1956. **Teak plantations - thinning research**. Proceedings of the 9th Silvicultural Conference, Dehra Dun. Part 2: 33-38.

A detailed account of the work and periodic results in the Wyanad and Nilambur divisions. Figures are provided to show that Craib-type thinnings give rapid diameter increment but less volume than D-grade thinnings, leaving height unaffected.

2246 Wanichkul, M. 1966. **A study on the growth and percentage of survival of teak stumps of different size and lengths**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Size and length of stumps have no effect on growth and survival percent, but stumps of 1.0 to 2.0 cm. diameter and 16-20 cm. long gave best survival.

2247 Watts, H.C. 1934. **Technique of teak plantation work**. Proceedings of the 4th Silvicultural Conference, Dehra Dun: p301.

2248 Wechel, A te. 1909. **An incomplete description of the principle of thinning in teak plantations**. Tectona 2(1): 74-77.

2249 Weidema, W.J. 1966. **An information on teak growth in Nicaragua**. Turrialba 16(4): 387-389.

A note on a promising 1-ha. plantation established in 1946. Total yield (including two thinnings) is estimated.

2250 Wepf, W. 1936. **Root competition and the balance applied in setting out and thinning teak**. (Dutch; English). Tectona 29(11/12): 847-856.

2251 White, K.J. 2002. **General plantation management**. TEAKNET Newsletter 26: 4p. 25.

2252 Wilson, C.C. 1934. **Early stump planting of teak**. Indian Forester 60(2): p171.

Reports on the Madras experiments in Nilambur and Wyanad.

2253 Wilson, C.C. 1938. **On teak plantations of Nilambur**. Inspection Notes on the forests of Nilambur Division.

The note gives recommendations on thinning in teak plantations.

2254 Wimbush, A. 1922. **Teak plantations**. Indian Forester 48(12): p687.

The author mentions an espacement of 8'x8' adopted in a Nilambur plantation and considers it as too wide resulting in catapult forking generally about 15 ft. from the ground level.

2255 Wiroatmodjo, R.S. 1953. **The rotation of teak**. (Javanese). Rimba Indonesia 2(5): 210-218.

After a discussion of the merits of long and short rotations the author recommends short rotations of 40 years and intensive management of forests.

2256 Wood, P.J. 1966. **A guide to some German forestry plantations in Tanga region**. Tanzania Notes and Records 66: 203-206.

The old German plantations since 1898 to 1911 are listed along with their provenance. Detailed notes are included on Kihuhwi, Amani, Muchesa, Steinbruch and Tanga region teak plantations.

2257 Wood, P.J. 1967. **Teak planting in Tanzania**. Proceedings of FAO Symposium, Man Made Forests, Canberra, Australia FO:MMF-6/10: 1631-1644.

Details of local seed stands and early German introductions dating from before 1914 are given, together with the location and description of today's plantation area. Nursery practice, general silvicultural techniques, the growth figures from sample and trial plots are also described. Reference is made to provenance, progeny and grafting trials to recent work on plantation and nursery diseases and to tests on the timber properties of Tanzanian grown teak.

2258 Wyatt Smith, J. 1967. **Interim note on experiments with different types and sizes of teak planting stock: Western Nigeria**. FAO Teak Sub-Commission, Rome: 4p. FAO, Rome.

2259 Zwart, W. 1937. **Selective thinning**. (Dutch). Tectona 30(3): 17-201.

Teak stands are analysed by tree types adapted from 'Schadeline'.

Go top

Field Trials

(See also 1692)

2260 Bhat, D.M; Hegde, H.G; Hegde, G.T; Murali, K.S. 2002. **Field performance of certain selected species in hilly region of high rainfall zone in Uttara Kannada District, Western Ghats, Southern India**. Myforest 38(4): 357-363.

Mean annual increment of collar diameter, height and volume was computed and a rank was developed. Teak was found fast growing with high survival next to *Acrocarpus fraxinifolius*.

2261 Muralidharan, E.M; Pandalai, R.C. 2000. **Assessment of field performance of micropropagated teak and Eucalypt**. KFRI Research Report 182: 21p. Kerala Forest Research Institute, Peechi.

A field trial was conducted at the KFRI Field Research Centre, Veluppadam, Thrissur, for assessing the performance of micropropagated plantlets of *Tectona grandis* and *Eucalyptus tereticornis* with respect to their vigour and field hardiness as compared to the conventional planting material used in forestry plantations. Observations on mean survival, height and girth at breast height were recorded at two monthly intervals. In teak, survival of both the propagules was above 90 per cent during the initial months. The survival rate was 76 percent in micropropagated teak plants and 83 per cent in conventional stump plants.

2262 Parashar, K.K; Tiwari, S.K; Dhuria, S.S. 1995. **Field trials of tissue culture grown plants of teak (*Tectona grandis* Linn.f.)**. Vaniki Sandesh 19(2): 1-3.

A preliminary note on the successful transfer of plants to the fields raised by tissue culture using shoots taken from seedlings raised from the seeds of plus trees.

2263 Subramanian, K; Thakare, A.R; Paranjpe, S.V; Khuspe, S.S. 1997. **Preliminary field trials with tissue culture plants of teak in Maharashtra**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 157-159. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Preliminary field trials on teak tissue culture plants were taken up in Maharashtra since 1978. The tentative results indicate that the growth performance of teak tissue cultured plants are better than that of the plants raised from conventional stumps or polypot plants. The applications of tissue culture technology in forestry and the emerging research needs are enumerated.

Go top

Fertilizer Trials

(See also 0196, 0243, 0625, 2153, 2963, 3435, 3707, 3980)

2264 **Application of farm-yard manure to teak seedlings**. Forest Research in India, 1930: p15.

2265 **Irrigated teak plantations**. Forest Research in India and Burma Part II, 1947: p53.

The stopping of irrigation after 4-6 years has no significant difference in mean height and were advocated at the end of four growing seasons.

2266 **Teak-manurial experiments in Nilambur**. Forest Research in India Part II 1954-55, 1955: p74.

Application of 4 oz., super-phosphate per plant promotes more rapid height growth. Further investigation are required to show whether weeding costs can be reduced to counter balance the cost of application of manure.

2267 Adukkham, S. 1962. **The scientific fertilizers as experimented with teak**. Thesis. Kasetsart University, Bangkok.

2268 Ananthapadmanabha, H.S; Nagaveni, H.C; Vijayalakshmi, G; Somashekar, P.V. 1998. **Comparative effect of inorganic and biofertilizer on growth of teak plants**. Indian Journal of Forestry 21(1): 1-3.

Six treatments were applied: application of calcium nitrate, diammonium phosphate, inoculation with *Glomus caledonium* VAM spores or composite teak rhizosphere VAM and no treatment. Plant growth, foliar nutrients and root VAM infection, and soil nutrients and VAM spores were measured for two years after treatment. All the treatments improved teak height growth, with the best growth in VAM treatment.

2269 Arthur, M.B. 1999. **The effect of compost and NPK fertilizer on growth performance of *Tectona grandis* Linn.f. seedlings in the nursery**. Ghana Journal of Forestry 8: 31-35.

An experiment was conducted at the Mesewam nursery of the Forest Research Institute of Ghana to examine the effect of cattle and poultry manure and NPK fertilizer on the growth performance of *Tectona grandis* seedlings. It was observed that except for number of leaves, growth media consisting of either cattle or poultry manure mixed with soil at a ratio 1:2 had a significantly better effect on growth than all the other treatments.

2270 Balagopalan, M. 1999. **Fertiliser recommendation for teak and eucalypt plantations**. Evergreen 43: 12-13. Kerala Forest Research Institute, Peechi.

From studies conducted at KFRI, recommendation is suggested for fertilizer application in teak and eucalypt plantations.

2271 Bale, A. 1977. **Effect of NPK fertilizers on yield of intercropped upland rice and growth rate of planted teak stands**. (Indonesian). Universitas Gadjah Mada, Yogyakarta: 15p.

2272 Barrett, R.L; Woodvine, F. 1971. **Possibilities for irrigated forestry in the Rhodesian Lowveld**. Rhodesian Forestry Commission, Forest Research Paper 1: 50p.

Tabulates data from 138 unreplicated trial plots of trees from 13 genera and 45 species including teak established since 1964 under irrigated conditions in this area of high average temperatures and low, erratic seasonal rainfall.

2273 Bhadran, C.A.R. 1959. **Irrigated teak plantations**. Indian Forester 85(6): 321-323.

Experiments undertaken to determine effect of irrigation on teak, best method of irrigation and optimum frequency, etc. Results indicate one irrigation of three hours once in fifteen days by percolation method gives best height growth.

2274 Bhat, K.M; Chacko, K.C; Balagopalan, M. 2001. **Evaluation of high input management on growth and timber production in teak**. KFRI Research Report 200. Kerala Forest Research Institute, Peechi.

Fertilization with irrigation had a significant effect on tree height and volume. Faster growth due to fertilization with irrigation in one-year-old seedlings increased the latewood width and fibre percentage resulting in higher density of wood.

2275 Bhatnagar, H.P; Gupta, B.B; Rauthan, B.S; Joshi, D.N. 1969. **Preliminary studies on the nutritional requirements of teak (*Tectona grandis*)**. Indian Forester 95(7): 488-495.

Nutrient solutions of N, P and K at 0, 340 and 680 mg./plant were applied to sand cultures. Data for height and weight increment and for chemical analysis of the seedlings are tabulated.

2276 Bheemaiah, G; Subrahmanyam, M.V.R; Ismail, S. 1997. **Performance of teak under different irrigation and fertilizer management practices**. Indian Forester 123(12): 1171-1175.

The treatments included three irrigation intervals of 10, 20 and 30 days and no irrigation control and four urea fertilizer application levels of 0, 100, 200 and 300 g/plant. Thirty months after planting, all the irrigation treatments had significantly influenced both the height and girth growth. Application of urea did not affect height and girth growth.

2277 Chakrabarti, C; Nashikkar, V.J. 1994. **Forest tree fertilization with sewage**. Bioresource Technology 50(3): 185-187.

A study was conducted in Nagpur to assess early growth response of some important forest tree species including *Tectona grandis* to sewage and sludge applications. Results showed that wastes had generally favourable effects on germination and early seedling growth of forest tree species.

2278 Coster, C. 1933. **Pilot tests in fertilising teak**. Tectona 26: p742.

2279 Coster, C. 1933. **Some orientating manuring experiments with teak**. (Dutch; English). Tectona 26(9): 742-762.

The manuring of forest crops vs. agriculture is discussed. Results indicate teak reacted favorably to manuring on extremely poor soils while on poor soils effect small or nil and super phosphate in extremely poor soils is more beneficial and agricultural taungya crop reacted quicker and better to manure.

2280 Drees, E.M. 1940. **Further results of some manuring experiments with teak**. (Dutch). Tectona 33: 591-606.

Applications of ammonium sulphate, potassium chloride and slaked lime had little or no beneficial effect upon the growth of teak. The effect of superphosphate varied widely on the different soils, and as knowledge of these is very scanty, field trials would be necessary to determine the effect of superphosphate on teak growth.

2281 Fagbenro, J.A; Agboola, D.A. 1993. **Effect of different levels of humic acid on the growth and nutrient uptake of teak seedlings**. Journal of Plant Nutrition 16(8): 1465-1483.

A greenhouse experiment to study the effect of humic acid on the growth and nutrient uptake of teak was conducted in Ibadan, Nigeria. The results indicated that humic acid was beneficial to the growth and nutrient uptake of teak seedlings. A significant positive correlation was established between rate of humic acid application and plant height, stem diameter and total dry matter yield in the Oxisol.

2282 Fernando, S.N.U. 1966. **Fertilization of teak nurseries**. Ceylon Forester 7(3/4): 103-106.

Teak seedlings in a Ceylon nursery, showing deficiency symptoms were treated with N, P and K fertilizers; they responded well to applications of N in inorganic form.

2283 Fonseca Gonzalez, W. 2000. **The application of chemical fertilizers to *Tectona grandis* Linn.f. in Guanacaste, Costa Rica**. Taller de nutricion forestal memoria, 2 de junio, CONARE, San Jose, Costa Rica: 39-44. E. Chaves Salas; J.F di Stefano Gandolfi; M. Arguedas Gamboa; E.M. Guier Serrano; S. Rojas Soto, Eds. Consejo Nacional de Rectores, San Jose, Costa Rica.

The effects of fertilizing 6-month-old plantations of *Tectona grandis* in Costa Rica with different formulations of NPK were assessed by measuring survival, and relative height and diameter growth over 66 months after treatment. The fertilizer treatments had no effect on survival, and the best growth promoting treatments with more N or N and P contents generally producing the best results at Nandayure.

2284 Forest Department, Andhra Pradesh. 1964. **A note on manurial trials in teak plantation**. Andhra Pradesh Forest Department.

The effect of adding N, P and K on plant growth is discussed along with other trace elements in the soils. The details of treatments and method of manurial application are suggested.

2285 Forest Department, Sudan. 1952. **Use of ammonium sulphate to stimulate the growth of teak stumps**. Report of Forest Department, Sudan 1950-1951: 41p.

Ammonium sulphate was put in the planting holes in direct contact with the roots.

2286 Gawande, S.R. 1991. **Stand density manipulation and fertilisation studies on teak**. M.Sc Thesis: 81p. Kerala Agricultural University, Thrissur, Kerala.

2287 Gogate, M.G; Farooqui, U.M; Joshi, V.S. 1995. **Growth responses to irrigation: Eksal (Ambhadi) teak plantation - a case study**. Indian Forester 121(6): 491-502.

Application of irrigation and NPK fertilizer resulted in gains over rainfed plantations. Judicious application of irrigation and a greater emphasis on genetic improvement is recommended.

2288 Gogate, M.G; Farooqui, U.M; Joshi, V.S. 1995. **Sewage water as potential for the tree growth: A study on teak (*Tectona grandis*) plantation**. Indian Forester 121(6): 472-481.

The discharge of sewage water is a primary source of pollution, especially near big cities. In a case study of teak plantations irrigated with sewage at Dhule, W. Maharashtra, tree growth was significantly higher in plots irrigated with sewage water than in those irrigated with well water. The prospects of using sewage water for irrigation are discussed.

2289 Haque, M.S. 1996. **Intensive management of teak (*Tectona grandis*) plantations under irrigation on farm lands - some observations**. Indian Forester 122(7): 641-645.

The paper discusses the technical feasibility and financial viability of intensive, irrigated teak plantations, based on observations made in Periyar District, Tamil Nadu, in plantations financed both by banks and farmers' own resources.

2290 Hassan, M.M; Dey, H.B. 1979. **Studies on the nutritional requirements of forest trees - optimum NPK doses for teak seedlings**. Bano Biggyan Patrika 8(1/2): 57-63.

All possible combinations of N, P and K were applied to 6-wk-old seedlings growing in sand culture. Seedlings were also supplied with a solution of micro-nutrients for the duration of the experiment. Best growth was obtained with N, P and K at 250 mg/plant monthly, at which concentrations N and P contents were greatest.

2291 Jackson, J.K. 1973. **Some results from fertiliser experiments in plantations**. Federal Department of Forest Research, Nigeria, Research Paper Savanna Series 23: 21p.

Summarizes the results of experiments covering ten species including *Tectona grandis*.

2292 Jadhav, B.B; Kenjale, R.Y; Chavan, S.A. 1995. **Effect of growth regulators on performance of teak (*Tectona grandis*), laurel (*Terminalia tomentosa*) and khair (*Acacia catecheu*) un-**

der Konkan condition. Indian Forester 121(7): 667-669.

One year old seedlings of *Tectona grandis* were transplanted into lateritic soil and sprayed separately with gibberellin, NAA or IBA. Height and diameter growth were recorded.

2293 Joshi, V.S; Farooqui, U.M. 1997. **Irrigated teak plantations in Maharashtra - a case study**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 46-51. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

A study was undertaken to evaluate the performance of teak plantations raised on agricultural/forest lands under irrigated conditions in different parts of Maharashtra and the results are highlighted.

2294 Kaul, O.N; Gupta, A.C; Negi, J.D.S. 1972. **Diagnosis of mineral deficiencies in teak (*Tectona grandis*) seedlings**. Indian Forester 98(3): 173-177.

N, P, and K deficiency symptoms confirmed those previously reported for Teak. Deficiency symptoms occurred in the absence of Ca, Mg and S are discussed.

2295 Kaupenjohann, M; Zech, W. 1992. **Potassium requirements of fast-growing tropical tree plantations**. Potassium in ecosystems: Biogeochemical fluxes of cations in agro and forest systems. Proceedings of the 23rd Colloquium of the International Potash Institute, Prague, Czechoslovakia, 12-16 October 1992: 325-343. International Potash Institute, Basel, Switzerland.

A review is made of world literature on K nutrition of plantations of species including *Tectona grandis*.

2296 Khandwe, R; Sharma, R.C. 2003. **Effect of drip irrigation on growth and production of teak (*Tectona grandis*) in Satpura plateau of Madhya Pradesh**. Research on Crops 4(1): 114-116.

Teak plants with drip irrigation gave the highest plant height with 97 percent survival after one year in comparison with traditional irrigation method having 74 percent survival.

2297 Kishore, N. 1987. **Preliminary studies on the effect of phosphatic fertilizers on teak plantation**. Indian Forester 113(6): 391-394.

Treatments applied were Missouri phosphate, diammonium phosphate and single superphosphate. The results indicate that diammonium phosphate increased height growth and all other treatments except the 120 g dose of superphosphate.

2298 Masilamani, P; Annadurai, K; Chinnusamy, C. 2000. **Effect of macro and micronutrients spray on seedling growth attributes of teak (*Tectona grandis* Linn.f.)**. Madras Agricultural Journal 87(7/9): 529-530.

This study was conducted to determine the effect of macro and micronutrients on growth of teak. Treated with urea, DAP, zinc sulfate, borax, potassium sulfate, muriate of potash and water as control, applied by foliar spraying.

2299 Maun, M.M. 1977. **Survival and growth of four reforestation species applied with slow-release tablet fertilizer**. Sylvatrop 2(3): 219-222.

Seedlings of species including teak were planted at Nueva Viscaya, Philippines with or without the addition of one Agriform slow-release tablet fertilizer to the planting hole. Survival was not affected by the fertilizer treatment in any of the species.

2300 Mishra, K. 1995. **Enhancement of seedling growth by the application of potassium on *Tectona grandis* Linn.f. and *Dendrocalamus strictus* Nees**. Indian Journal of Forestry 18(4): 325-327.

Maximum growth enhancement was with the 1000 ppm treatment for *T. grandis*. Higher concentrations tended to reduce growth and cause the formation of pale green leaves.

2301 Mohan Kumar, B. 2003. **Sustainable teak plantations in the tropics: A question of nutrient management**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Sustainability of monocultural plantations, teak in particular, has been questioned recently, because of their adverse effects on soils. Summarise here the current state of knowledge on nutrient management of teak.

2302 Mutanal, S.M; Nadagoudar, B.S. 2003. **Intensive management of teak (*Tectona grandis*)**

plantation through fertigation. Indian Journal of Agricultural Sciences 73(6): 352-355.

Irrigation was provided to planted teak through drippers on alternate days. Biomass of teak increased 36 percent with fertigation in six splits as compared to two splits of fertigation. Fertigation resulted in a 33 percent saving in fertilizers.

2303 Mutanal, S.M; Prabhakar, A.S; Nadagoudar, B.S. 2000. **Fertigation and its influence on biomass and nutrient uptake in teak**. Karnataka Journal of Agricultural Sciences 13(3): 670-675.

A field trial on fertigation in teak was conducted in Karnataka using trickle irrigation. Uptake of nutrients was in order of N K P and increased with increase in levels of fertilizer dose. Total biomass of teak increased by 20 and 30 percent. Fertigation saved NPK by 33 percent compared to soil application.

2304 Mutanal, S.M; Prabhakar, A.S; Nadagoudar, B.S. 2000. **Fertigation studies in teak**. Karnataka Journal of Agricultural Sciences 13(4): 1036-1039.

An experiment was conducted at teak farm in Karnataka under drip irrigated conditions to investigate the effect of fertigation on the growth of teak.

2305 Mutanal, S.M; Prabhakar, A.S. 2001. **Growth and productivity of teak (*Tectona grandis*) under fertigation through drip irrigation system**. Indian Journal of Agricultural Sciences 71(6): 384-386.

Teak plants were supplied with different NPK fertilizer in a field experiment conducted in Karnataka. Plant height, diameter at breast height, basal area and volume values were measured. The interaction between fertigation rates and frequency was significant for plant height at 24 months and between diameter at breast height and volume at 28 months.

2306 Mutanal, S.M; Prabhakar, A.S; Nadagoudar, B.S; Mannikeri, I.M. 2001. **Growth pattern of teak under fertigation system**. Indian Journal of Forestry 24(3): 297-300.

Results of the experiment conducted on integrated nutrient management in teak through different levels and frequencies of fertigation are presented.

2307 Mutanal, S.M; Prabhakar, A.S; Nadagoudar, B.S. 2002. **Integrated nutrient management in teak through fertigation**. Indian Forester 128(3): 341-347.

An experiment was conducted on integrated nutrient management in teak through fertigation in Dharwad, Karnataka. Total biomass, height, diameter at breast height and basal area are increased by the fertigation.

2308 Nobuchi, T; Okada, N; Nishida, M; Siripatanadilok, S; Veenin, T; Tobing, T.L; Sahri, M.H. 2003. **Some characteristics of wood formation in teak (*Tectona grandis*) with special reference to water conditions**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Investigated the characteristics of wood formation in relation to water conditions. In Java islands, Indonesia, trees of 2 areas, Sukabumi and Cepu were compared. In Sukabumi that belongs to tropical rain forest area less distinct growth rings were observed than Cepu that has clearly dry season. Heartwood color also has the difference. In Malaysia growth rings of 14 years old plantation grown tree were investigated.

2309 Nwoboshi, L.C. 1973. **The effects of potassium supply on growth and nutrient composition of teak (*Tectona grandis*) seedlings**. Potassium in tropical crops and soils: Proceedings, 10th Colloquium, International Potash Institute, Abidjan: 513.

The dry weight of teak seedlings increased with increasing amounts of K applied as KNO_3 maximum at 109.2 p.p.m. and remained constant to 312 p.p.m. Foliar contents of Mg, Ca and P were reduced.

2310 Nwoboshi, L.C. 1984. **Growth and nutrient requirements in a teak plantation age series in Nigeria. II. Nutrient accumulation and minimum annual requirements**. Forest Science 30(1): 35-40.

Accumulation and annual requirements of N, P, K, Ca and Mg were calculated using bole, leaf and branch samples from trees. The proportions of all elements channelled to the foliage decreased, while those to the trunk and branches increased with age. Implications of this distribution and of harvesting intensity on site nutrient budgets are discussed.

2311 Ojo, G.O.A; Jackson, J.K. 1974. **The use of fertilizer in forestry in the drier tropics**. (French). Colloque international sur l'utilization des engrais en foret [FAO IUFRO International symposium on forest fertilization], Paris, France, 3-7 December 1973: 339-353. Ministere de l'Agriculture, Service des Forets, Paris, France.

In field trials, P often produces responses, response to N is often absent unless P is also applied. N sometimes increases growth during the wet season but causes reduced growth or mortality during the next dry season. Only a few cases of favorable response to K have been noted.

2312 Prasad, R; Sah, A.K; Bhandari, A.S. 1986. **Fertilizer trial in ten and twenty years old teak plantations in Madhya Pradesh**. Journal of Tropical Forestry 2(1): 47-52.

After five years, fertilizer treatment significantly increased height and d.b.h. in compared with controls and volume production in the 10-yr-old plantation.

2313 Raigosa, J; Ugalde Arias, L.A; Alvarado, A. 1995. **Initial response of *Tectona grandis* Linn.f. to fertilization with farmyard manure, ash, KCl and NPK in Guanacaste, Costa Rica**. Conference Proceedings of Seminario Technico Sobre Fertilizacion Forestal, Panama, 3 July 1995: 37-46. C.R.V. Osorio, Ed. CATIE, Panama.

2314 Rangaswamy, C.R; Jain, S.H; Sarma, C.R. 1990. **Effect of inorganic fertilizers on seedlings of casuarina, sandal and teak**. Myforest 26(4): 323-326.

Height, dry weight production and nutrient (NPK) analyses were carried out and found that the treatments increased growth and nutrient contents in casuarina and teak.

2315 Rangaswamy, C.R; Jain, S.H; Sarma, C.R. 1991. **Effect of inorganic fertilisers on seedlings of casuarina, sandal and teak**. Myforest 27(1): 35-38.

NPK fertilizer boosted the growth of seedlings of *Casuarina equisetifolia* and teak in polybags.

2316 Rawat, J.K. 1995. **Value of a 20-year old irrigated teak plantation**. Indian Forester 121(6): 553-557.

Growth and yield data for Indian teak plantations and prices and price trends for teak wood are used to estimate the value of a 20-year-old irrigated teak plantation.

2317 Roessel, B.W.P. 1936. **Fertilizing teak plantations**. (Dutch; English). Tectona 29(2/3): 83-100.

The author considers burning experiments in teak plantation sites gave same effect as manuring in poor sites, where silviculturally mixed plantations are not feasible. The author pleads for more comprehensive study of manuring vs. cost and profitability.

2318 Schnepper, W.O.R. 1934. **Application of artificial fertilizer to forest cultivation**. Tectona 27: 417-440.

2319 Siddappa Kannur; Devar, K.V. 2003. **Effect of fertilizers on the seedling growth of teak**. Myforest 39(2): 153-157.

2320 Singh, U; Gurumurti, K. 1984. **Oil cakes from oilseeds of forest origin - their potential as fertilizer**. Indian Journal of Forestry 7(1): 12-18.

Important and unexploited species producing oil-bearing seeds are listed and NPK contents of different cakes are estimated. Research has shown that diameter production in the first year of growth can be increased by more than 100 percent in *Tectona grandis* by application of different tree cake fertilizers.

2321 Subramanian, V; Rajendran, K; George, M. 1998. **Influence of bio-fertilizer and conservation of moisture on growth of young teak plantation**. (Indonesian). Advances in Forestry Research in India 19: 119-127.

A field experiment was conducted to investigate the effect of biofertilizers and coir pith on the growth performance of young teak plantation. It is suggested that application of biofertilizers along with mulch can be applied during the establishment phase of teak plantations to increase survival percentage as well as productivity.

2322 Sundralingam, P. 1982. **Some preliminary studies on the fertilizer requirements of teak**. Malaysian Forester 45(3): 361-366.

Teak seedlings in nursery seed beds at Kepong, Peninsular Malaysia, at 4 wk old showed deficiency symptoms which disappeared after fertilizing. Height and diameter growth responded well to NP treatments.

2323 Thaiutsa, B; Kaitpraneet, W; Suwannapinunt, W; Khemnark, C. 1976. **Responses of teak to nitrogen and phosphorus fertilization**.

(Thai). Faculty of Forestry, Kasetsart University, Thailand, Research Note 21: 14p.

10-yr-old teak trees were treated with ammonium phosphate at 2.1 kg/tree. After 1 yr there was no significant difference between treated and untreated trees in height, relative height or d.b.h. increments. Thinning, rather than fertilizing is recommended for enhancing the diameter growth of teak in the early growing period.

2324 Torres, S; Marquez, O; Hernandez, R; Franco, W. 1993. **Initial growth response of teak to phosphorus in the western plains of Venezuela**. (Spanish). Turrialba 43(2): 113-118.

Analysed the effect of rock phosphate fertilizer on the growth of 2-, 7- and 12-year-old teak plantations on alluvial soils. On sites with moderate drainage, the 2-year-old plantations showed a significant response in both diameter and height growth to the fertilizer. The role of Ca in the observed response is discussed.

2325 Wang, B.G; Lu, L.H. 1996. **Soil nutrition condition and its management in the nurseries of Guangxi Daqingshan Mountain**. Forest Research 9(4): 403-408.

Investigations were made in nurseries growing seedlings of species including *Tectona grandis*.

Go top

Agroforestry

(See also 0096, 2872, 3506)

2326 **Reproduction of teak by means of taungyas**. Indian Forester 24(2), 1898: 62-66.

Details of teak regeneration under taungya system and remarks on Tharrawaddy taungyas are given.

2327 **Underplanting experiments of teak in Madras**. Forest Research in India, 1930: p85.

2328 **The influence of agricultural crops in taungya plantations on the growth of teak**. Indian Forester 62(10), 1936: 661-662.

Taungya cultivation is generally considered harmful and recommends studies on retarding effect of taungya crops due to shade and root competition on teak.

2329 **The effect of different Kumri crops on teak**. Forest Research in India and Burma Part II, 1947: p53.

Field crops like hill paddy, chillies and ginger are found to have significant effect on growth of teak.

2330 **Effect of different kumri crops on teak raised with them**. Forest Research, India and Burma 1948/49, Part. I, 1952: p37.

The field crops like paddy, chillies, cotton, millet, tapioca, horse gram, and ginger are found grown along with teak without causing significant loss in height growth. Maize reduce height growth of teak.

2331 **Leguminous creepers in younger teak plantations**. Forest Research in India Part II, 1951-52, 1952: p38.

The effect of leguminous creepers like *Centrosoma pubescens, Pueraria javanica* and *Calapogonium* species on the growth of teak is studied and found that it retarded the growth of teak.

2332 **Report on Madagascar**. (French). Proceedings of the First Conference on Forestry Inter African Countries, Abidjan, 1951, 1952: 521-544.

The topography, agriculture practices and general lack of control make forestry worse in this country. The effect of having forests at the mercy of local interests is emphasized. Teak is considered as one of the species to be used for planting.

2333 **Teak plantations with kumri crop**. Forest Research in India Part II 1954-55, 1955: p74.

It is reported that there is no difference in the growth of teak raised with common Kumri crops like hill paddy, chillies, cotton, ragi, tapioca and horse gram.

2334 **Teak: Underplanting**. Forest Research in India, 1955.

Underplanting is observed to reduce diameter increment of teak though not significantly.

2335 Aguirre, A. 1963. **Silvicultural and economic study of the taungya system in the conditions of Turrialba**. (Spanish). Turrialba 13(3): 168-171.

Survival and growth of teak and some other trees planted with agricultural crops and without agricultural crops at 6 months and establishment costs are compared. *Tec-*

tona grandis and *Cordia allidora* appear suitable for reforestation.

2336 Alexander, T.G; Shobhana, K; Balagopalan, M; Mary, M.V. 1980. **Taungya in relation to soil properties, soil erosion and soil management**. KFRI Research Report 4: 24p. Kerala Forest Research Institute, Peechi.

Agrisilvicultural practices in relation to soil properties, soil erosion and soil management was taken up with the objectives of evaluating changes in soil properties due to taungya practices, assessing the extent of soil erosion in taungya plantations and improving the management of soils during the first two years of forest plantations.

2337 Allan, C.W. 1916. **Teak taungya plantations in the Henzada-Maupin Division**. Indian Forester 42(11/12): 533-537.

The taungya method of raising teak plantations is described together with details of method and costs.

2338 Alphen de Veer, E.J Van. 1957. **Teak cultivation in Java**. Tropical Silviculture 2, FAO Forest and Forest Products Studies 13: 216-232.

Describes the method of artificial planting of teak under taungyas and underplanting with *Leucaena glauca*. Teak forests are found on margalite soils of tertiary origin, in the low land upto 500m. above sea level in islands of Java and Muna.

2339 Alrasjid, H. 1985. **Plantation trial of ebony (*Diospyros celebica*) under a teak stand in Java**. Buletin Penelitian Hutan, Pusat Penelitian dan Pengembangan Hutan 464: 23-37.

Growth data showed a large variation which was attributed to differential soil fertility.

2340 Arifin, M. 1983. **Enlargement of planting space in intercropping system**. (Indonesian). Duta Rimba 9(57/58): 24-26.

An increase in spacing was tested in intercropping trials with food crops in Indonesia.

2341 Aung Thant Zin, U. 2004. **A teak based multistoried agroforestry system**. TEAKNET Newsletter 32: p6.

Discussed the achievement made by the ITTO project implemented by the Forest Department of Myanmar.

2342 Bale, A. 1980. **The development of teak plantation under taungya system in Java**. Gadjah Mada University, Yogyakarta, Indonesia.

2343 Bale, A. 1981. **Intensification trials of the taungya system in teak forests on Java**. Observations of agroforestry on Java, Indonesia. Report on an agroforestry course, Forestry Faculty, Gadjah Mada University, Yogyakarta: 97-104. K.F. Wiersum, Ed. Department of Forest Management, Agricultural University, Wageningen, Netherlands.

Use of various dryland rice varieties for interplanting and the effect of fertilizing is studied.

2344 Baminiwatte, A.N.S. 2003. **An appraisal of teak farmer's woodlots in Sri Lanka and the relevant management strategies**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Based on the experiences gathered from the previous and the present agroforestry programmes, discusses the problems associated with managing the farmer's woodlots and recommends measures for improved management.

2345 Bhatia, K.K. 1958. **A mixed teak forest of Central India**. Journal of Ecology 46(1): 41-63.

Analysis of the vegetation of a mixed deciduous teak forest at Sagar, Central India revealed four forest types which include mixed *Tectona grandis*. Soils under each subtype and regional ecological factors were studied. The present mixture of types is due to the heterogeneity of environmental factors, the absence of species able to cover the whole range of habitats, seral development and the adjustment of plants to biotic pressure. Successional trends are indicated.

2346 Bhople, R.S; Shinde, P.S; Marawar, S.S; Zade, U.B. 1999. **Constraints faced by growers in use of recommended practices of teak**. Indian Journal of Forestry 22(1/2): 145-148.

Farmers in Akola District, Maharashtra have been planting commercial teak on their land as part of a social forestry programme. Constraints felt by the farmers in adopting teak planting are listed and briefly discussed. Appropriate improvements are suggested.

2347 Boonkird, S. 1978. **Taungya system: Its applications, ways and means of improvement in Thailand**. Proceedings of the 8th World Forestry Congress, Jakarta, 16-28 October 1978, World Forestry Congress: Forestry for Food FFF-7-5: 18p.

A description of the forest village system for cultivating teak with farm crops in between is given.

2348 Braat, C.G.S. 1912. **Underplanted crop *Leucaena glauca***. Tectona 5: 522-523.

2349 Bryant, R.L. 1994. **From laissez-faire to scientific forestry: Forest management in early Colonial Burma 1826-85**. Forest and Conservation History 38(4): 160-170.

Laissez-faire practices allowed widespread over harvesting of teak after British colonization of the province of Tenasserim in Burma. This practice was widely criticised, and following the second Anglo-Burmese war resulted in the creation of the Burma Forest Department in 1856. An account is given of the taungya system introduced by the Forest Department for promoting cooperation with local forest users.

2350 Bryant, R.L. 1994. **Shifting the cultivator: The politics of teak regeneration in colonial Burma**. Modern Asian Studies 28(2): 225-250.

Examines the use of the taungya system for teak regeneration in Burma as a means of political and economic control of the shifting cultivation system of the hill karen.

2351 Bryant, R.L. 1994. **The rise and fall of taungya forestry: Social forestry in defence of the empire**. Ecologist 24(1): 21-26.

The development of the taungya system of agroforestry by the British in the teak forests of Burma is discussed in relation to interaction and tensions between the British government's forestry service and the shifting cultivators who inhabited the forests, its effectiveness as a sustainable forestry system compatible with shifting agriculture and the likelihood of similar social tensions in its application today.

2352 Buvaneswaran, C; George, M; Manivachakam, P; Subramanian, V. 2001. **Comparative studies on performance and productivity of teak (*Tectona grandis* Linn.f.) in farmland and in forest plantation**. Range Management and Agroforestry 22(1): 113-117.

Teak plantations grown in a farmer's field were studied and compared with a 20-year-old teak plantation grown in a forest land in Coimbatore, Tamil Nadu.

2353 Carpenter, P.H. 1929. **Tea in North East India**. Agriculture Journal India, Calcutta 24:p 52.

Report on the insect *Zeuzera coffeae* which attacks tea and teak.

2354 Chandrashekara, U.M. 1996. **Ecology of *Bambusa arundinacea* (Retz.) Willd. growing in teak plantations of Kerala, India**. Forest Ecology and Management 87(1/3): 149-162.

A study was undertaken to assess the contribution of bamboo to the vegetation structure, biomass productivity and nutrient cycling in teak plantations in the Kariem-muriem Forest Range, Kerala. From the nutrient conservation and cycling point of view, teak is find suitable in moderately bamboo rich area and bamboo poor area.

2355 Chandrashekara, U.M. 1996. **Ecological studies on *Bambusa arundinacea* (Retz.) Willd. growing in teak plantations of Kerala, India**. KFRI Research Report 107: 33p. Kerala Forest Research Institute, Peechi.

A study was undertaken to assess the contribution of bamboo to the vegetation structure, biomass productivity and nutrient cycling pattern in 15-20 year old teak plantations of Kariem-muriem Forest Range, Kerala. The results show that from the nutrient conservation and cycling point of view teak is find suitable for moderately bamboo rich area and bamboo poor area.

2356 Chandrashekara, U.M. 1996. **Studies on growth and architecture of tree species of home garden agroforestry systems of Kerala**. KFRI Research Report 101: 38p. Kerala Forest Research Institute, Peechi.

Characters such as crown architecture, growth, leaf phenology and branching pattern were studied in nine forest trees which include teak growing in home gardens in Panancherry Panchayat, Kerala, with a view to assessing their suitability as components in home garden agroforestry systems.

2357 Chandrashekara, U.M. 1997. **Growth and architectural analysis of trees of agroforestry importance in Kerala**. Range Management and Agroforestry 18(2): 151-163.

Characters such as crown architecture, growth and branching pattern were studied in nine forest tree species including *Tectona* *grandis* grown in home gardens in Panancherry Panchayat, Kerala, with a view to assessing their suitability as components in home garden agroforestry systems.

2358 Chantraprapa, S; Eiumnoh, A. 1991. **Agroforestry of Klang-Dong forest station**. International Workshop on Conservation and Sustainable Development, 22-26 April 1991, AIT-Bangkok and Khao Yai National Park, Thailand: 369-371. Asian Institute of Technology, Bangkok.

A brief account is given of the introduction of agroforestry techniques into a reforested area of the Dong Phaya Yen National Forest Reserve at Klang-Dong, Thailand. A scheme involving intercropping of food crops in the teak plantations was set up. Brief details are given of management, economic and social aspects of the scheme, and of problems which have occurred.

2359 Clifford, J.D. 1917. **Formation of teak taungya plantations in Burma**. Indian Forester 43(3): 117-121.

The method of counting seedlings is critically examined and a note is added on the size and method of teak taungyas.

2360 Clubbe, C.P; Jhilmit, S. 1994. **The potential of the forestry sector as a contributor to sustainable agriculture**. Proceedings of the 6th Annual Seminar on Agricultural Research (Sustainable Agriculture), Trinidad and Tobago, 3-4 November, 1992: 135-146.

2361 Coster, C. 1939. **Grass: Teak taungya plantations**. Indian Forester 65(3): 169-170.

Experience of teak taungyas in Java showed that teak is susceptible to root competition especially to grass and to prevent grass growth, interculture of alternate lines of *Leucaena glauca* is recommended.

2362 Coster, C; Kardjowasono, M.S. 1935. **The influence of agriculture crops in taungya plantations on the growth of teak**. (Dutch; English). Tectona 28(6): 464-487.

The taungya method of teak cultivation and various experiments on different agricultural crops are described. The growth of teak with reference to effect of agricultural crops and *L. glauca* are discussed.

2363 Dagar, J.C; Singh, G; Singh, N.T. 1995. **Evaluation of crops in agroforestry with teak (*Tectona grandis*), maharukh (*Ailanthus excelsa*) and tamarind (*Tamarindus indica*) on reclaimed salt affected soils**. Journal of Tropical Forest Science 7(4): 623-634.

To identify suitable crops for growing in interspaces of plantations including teak on reclaimed salt affected soils, various combinations of crops were examined. A reduction in yield of all the crops interplanted in the plantations is reported.

2364 Daradi, R.B. 1980. **The effect of intercropping of ipil-ipil (*Leucaena glauca*) on teak**. (Indonesian). Gema Rimba 6(41/42): 53-55.

2365 Dauget, J.M; Dupuy, B; N'Guessan, A. 1990. **An architectural analysis of a mixed plantation of samba and teak**. (French). Bois et Forests des Tropiques 224: 21-26.

A method of assessing stand structure using profiles to complement quantitative tree data is presented.

2366 Dawkins, C.G.E. 1922. **Big Hnaw (*Adina cordifolia*) and teak trees**. Indian Forester 48(2): 108-110.

From Zigon Division of Burma a big teak tree measuring 18'2" girth c.b. at b.h. with an yield of 957.1 cu.ft. was reported.

2367 De, R.N. 1938. **Effect of grass on teak seedlings**. Indian Forester 64(9): 563-564.

In Goalpara Division, Assam, grass is observed to slow down growth of teak seedlings.

2368 Deventer, A.J van. 1913. **Mixtures in teak forests**. (Dutch; English). Tectona 6: 273-293.

2369 Dhanda, R.S; Sidhu, D.S. 2003. **Prospects and potential of growing teak in agroforestry in Punjab**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

The growth performance of the trees planted have been measured and estimated their timber volume. The information derived prompts the authors for successful cultivation of teak in some parts of the state. Plantation strategies on farm border rows and farm steads in agrisilviculture systems for adoption by the farmers have been discussed. The aftercare and management strategies to protect teak trees from frost damage in early stages, fire and wind damage have been mentioned. Future scope and suitable extension strategies for quality teak plantations in the north-western states of India have been elaborated.

2370 Drees, E.M. 1949. **Bordered trial plots for testing the influence of interplanted rows of green-manuring crops in teak forests**. (Dutch). Tectona 39(4): 302-312.

Use of bordered plots for planting is explained which consist of a central plot bordered by a border plot, the two plots are separated by an insulation or buffer strip.

2371 Eidmann, F.E. 1932. **Underplanting in teak plantations**. (Dutch; German). Tectona 25(4): 671-690.

2372 Forest Department, Madras. 1942. **On underplanting teak**. Annual Report of Silvicultural Research in the Madras Presidency for year 1940-41: p85; 28.

It has been shown that *Swietenia macrophylla* and *Cedrela toona* can be successfully underplanted under quality teak of about 37 years of age if plants are introduced in dense lines in order to reduce browsing damage.

2373 Forest Department, Maharashtra. 1949. **Bamboo growth outting in teak plantations**. Annual report, Silviculture Research, Bombay state 1948-49.

Cutting bamboo in July and regrowth clearance in August has given encouraging results in Kanara district of Mysore.

2374 Gajaseni, J. 1990. **Diversified agroforestry system**. Symposium on agroforestry systems and technologies, Bogor, Indonesia, 19-21 September 1989. BIOTROP-Special-Publication 39: 157-161. C.F. Jordan; J. Kartasubrata; S.S. Tjitrosomo; R.C. Ummaly, Eds.

A brief account is given of a further development of the Thai forest village system, in which teak is planted at wider spacings and interplanted both with other forest trees and with agricultural crops.

2375 Gajaseni, J; Matta Machado, R. 1996. **Diversified agroforestry systems: Buffers for biodiversity reserves, and land bridges for fragmented habitats in the tropics**. Biodiversity in managed landscapes: Theory and practice: 506-513. C.F. Jordan; R. Szaro; D.W. Johnston; L. Umans, Eds. Oxford University Press, New York .

A short discussion, with an outline of a case study in Thailand, in which an experimental taungya system was used to improve the biodiversity by planting fruit trees after the grain crop in a teak plantation.

2376 Gonggrijp, L. 1928. **Artificial mixing of Tectona with other species**. (Dutch; English). Tectona 21: 774-794.

Roosendael report on mixed teak plantations suggests that in good soil areas suitable for planting teak, less costly measures to safeguard soil and also increase proportion of teak for better and increased output from these plantations.

2377 Gonggrijp, L. 1929. **International artificial mixing of teak and other timber species**. (Dutch; English). Tectona 22: 2187-2194.

2378 Gowri, K.V; Subrahmanyam, M.V.R; Bheemaiah, G. 2000. **Influence of leguminous and non-leguminous tree species on yield and economics of rainfed groundnut under nitrogen and phosphorus fertilization**. Indian Journal of Agricultural Sciences 70(6): 413-415.

In a field groundnuts were grown alone or alley cropped between *Albizia lebbeck* or *Tectona grandis* trees and were given fertilizers. Net returns and benefit:cost ratio were highest in pure stand and increased with fertilizer application.

2379 Granert, W.G; Cadampog, Z. 1980. ***Leucaena* as a nurse tree**. Leucaena Newsletter 1: p21.

Stems were straighter with less branching on plots with nurse trees.

2380 Gupta, R.K. 1993. **Multipurpose trees for agroforestry and wasteland utilisation**. 562p. Oxford & IBH Publications, New Delhi.

Introduction part gives an overview of the use of multipurpose trees in environmental protection, for the rehabilitation of waste lands and by small and marginal farmers and the landless. The major section discusses multipurpose trees in relation to the ecological regions of India, delineating the major phytogeographical zones and their vegetation types and listing and describing the various agroforestry systems utilizing multipurpose trees in the different regions of the country. Part two gives the descriptions of different multipurpose trees which include *Tectona grandis* and references are given after each species description as well as at the end of the book.

2381 Haque, M.S; Osman, K.T. 1993. **Performance of gurjan (*Dipterocarpus turbinatus*) and teak (*Tectona grandis*) in pure and mixed plantations at Kaptai, Bangladesh**. Indian Forester 119(9): 738-743.

Greater diameter of teak in the mixed plantation is reported. The mixed species site had a higher moisture content, and this is suggested as a possible reason for better teak growth.

2382 Hart, H.M.J. 1931. **Mixed teak plantations-Two parts**. (Dutch; English). Tectona 24: 88; 488-511.

2383 Heringa, P.K. 1929. **The introduction of *Biza orellana* Linn. as under-growth in teak forests**. Tectona 22: 263-267.

2384 Jimenez, M; Rodriguez, A; Montalvo, J.M; Alvarez, L. 1988. **Evaluation of *Coffea arabica* in association with forest trees on terraces in the Sierra del Rosario, Pinar del Rio, Cuba**. (Spanish). Revista Forestal Baracoa 18(1): 65-78.

Coffee yields were measured after 15 years in association with different species including *Tectona grandis*. Highest yields were with *T. grandis*. Growth of *T. grandis* was not affected by the presence or absence of coffee.

2385 Jordan, C.F; Gajaseni, J. 1990. **Interplanting of *Tamarindus indica* L. in teak plantations**. Fast growing trees and nitrogen fixing trees: International Conference, Marburg, 8-12 October 1989: 76-81. D. Werner; P. Muller, Eds. Gustav Fischer, Stuttgart, Germany.

In the Forest Village System of Thailand taungya is practised in teak plantations interplanted with *Tamarindus indica*.

2386 Joshi, M.D. 1967. **Cultivation of *Rauwolfia serpentina* as an intercrop in teak plantations**. Proceedings of the 11th Silvicultural Conference, Dehra Dun Item V B. Forest Research Institute, India.

The desirability of cultivation of *Rauwolfia* in an intensive manner as an intercrop in teak planting is discussed. It is considered as very economical. The paper describes briefly the method of cultivation, expenditure incurred etc. and yield.

2387 Kapp, G. 1988. **The forest-village model of the Thai state**. (Thai; English). Plant Research and Development 27: 8-11. Translated from Allgemeine Forstzeitschrift 42, 1986: 1064-1065.

As a consequence of population growth and immigration, agriculture in Thailand has expanded at the expense of forests. A project to combat this trend is the forest village programme initiated by the Thai Forest Industry Organisation. An afforestation programme is carried out under this programme.

2388 Kapp, G.B; Beer, J; Lujan, R. 1997. **Species and site selection for timber production on farm boundaries in the humid Atlantic lowlands of Costa Rica and Panama**. Agroforestry Systems 35(2): 139-154.

The CATIE-GTZ Agroforestry Project set up experiments with five timber tree species including teak planted in twelve farm boundaries in Costa Rica and Panama in cooperation with local farmers. In view of these excellent growth rates, planting of *Cordia alliodora*, *Eucalyptus deglupta* and *Tectona grandis* in lines on farm boundaries is recommended.

2389 Kerbert, H.J. 1904. **The cultivation of teak in connection with edible rice**. Journal Industry and Agriculture.

2390 Kerbert, H.J. 1908. **An observation with interplanting with *Leucaena glauca***. Tectona 1: p336.

2391 Kermode, C.W.D. 1939. **Mixtures in plantations Paper II**. Proceedings of the 5th Silvicultural Conference, Dehra Dun: 362-372. Forest Research Institute, Dehra Dun.

Presents an account of experimental mixtures of teak with cutch and *Xylia dolabriformis* followed in Burma.

2392 Kermode, C.W.D. 1952. **The use of taungya in natural regeneration operations**. Burmese Forester 2(2): 65-70.

Examples are described from dry teak forest and eastern laterite evergreen.

2393 Koppikar, V.B. 1950. **Some observations on mixed planting of *Ocimum kilimandscharicum* (camphor-yield Tulsi plant) and young teak**. Indian Forester 76(9): p405.

It is suggested that the highly aromatic *Ocimum* has a toxic effect on very young teak.

2394 Krishnaswamy, V.S. 1956. **Cover and nurse crops in sal (*Shorea robusta*) and teak (*Tectona grandis*) plantations at Dehra Dun**. Indian Forester 82(4): 153-170.

Describes a series of investigations to determine the practicability of improving and accelerating the establishment of sal and teak plantations on exhausted agricultural land by the use of nurse and cover crops.

2395 Kumar, B.M; Kumar, S.S; Fisher, R.F. 1998. **Intercropping teak with *Leucaena* increases tree growth and modifies soil characteristics**. Agroforestry Systems 42(1): 81-89.

The effects of intercropping with *Leucaena leucocephala* on early teak growth and soil properties in a simulated taungya system were evaluated in a humid tropical region in central Kerala. Teak growth increased with increasing relative proportion of *Leucaena* in the mixture.

2396 Kushalappa, K.A. 1982. **Teak underplanting**. Myforest 18(4): 159-161.

A brief account of teak underplanting in the open deciduous forests of Karnataka.

2397 Lahiri, A.K. 1972. **Intercropping trials with turmeric in North Bengal**. Indian Forester 98(2): 109-115.

Data shows that turmeric improving the growth of the forest crop. Recommendations are made on site preparation, planting, spacing, weeding and earthing, time of harvesting and control of diseases and pests. It is concluded that intercropping with turmeric can be a substantial source of extra income in forest plantations.

2398 Lahiri, A.K. 1987. **A note on prospects of *Tectona grandis* and *Xylia dolabriformis* mixture in North Bengal**. Indian Journal of Forestry 10(3): 232-233.

A mixed plantation was established in West Bengal. It is suggested that *X. dolabriformis*, which is fire resistant like teak is a suitable species for growing with teak in the region.

2399 Lahiri, A.K. 1989. **Taungya based agroforestry trials in West Bengal**. Indian Forester 115(3): 127-132.

An account of research on the taungya system in West Bengal since 1965 is given. The effect of spacing on the growth of teak with and without intercrops, sequential cropping, the effect of plantation age on the yield of various intercrops and the growth of the forest species under these conditions, the performance of a 3-tier cropping systems, etc. are discussed.

2400 Lal, A.B. 1942. **Significance of teak-sal mixture from the standpoint of plant succession**. Indian Forester 68: 181-187.

In the Kanker range the mixture is rare since teak tends to be suppressed by sal. It is argued that this is due to the silvicultural characters of sal, including shade tolerance and relatively better growth, as well as to local site conditions, which are more favourable to sal than to teak.

2401 Lamb, A.F.A. 1955. **Forestry on private estates**. Journal of the Agricultural Society of Trinidad and Tobago, Port of Spain 55(2): 169-183.

Discusses the long-term prospects of growing timber trees including teak for profit on sites unsuitable for plantation crops, with information on site requirements, propagation, protection and uses.

2402 Laurie, M.V. 1939. **Mixtures in plantations**. Proceedings of the 5th Silvicultural Conference, Dehra Dun: 349-362. Forest Research Institute, Dehra Dun.

Discusses the possibilities of raising teak in mixtures with nine other timber species and bamboos.

2403 Leete, F.A. 1912. **Pyinmana Forest Division: Teak and bamboos in Burma**. Indian Forester 38(8): p583.

It is suggested that exploitation plans of teak should take into consideration bamboo flowering.

2404 Leete, F.A. 1912. **Pyinmana forest division: Teak and bamboos in Burma**. Indian Forester 38: 249-255.

Importance of bamboo flowering *vis a vis* natural regeneration and exploitation of teak in Burma.

2405 Lottie. 1919. **A plea for teak taungyas**. Indian Forester 45(1): 6-10.

In view of the predominance of teak in unclassed forests and unreserves, the author considers taungya system is more suitable to Burma conditions.

2406 Macedo, R.L.G; Venturin, N; Gomes, J.E; Oliveira, T.K de. 2002. **Dynamics of establishment of *Tectona grandis* Linn.f. associated with coffee plantations in Brazil**. (Portuguese). Brasil Florestal 21(73): 31-38.

No significant difference found for the spacings studied. The results suggest that teak plantlets should be rooted first and planted one year before or at the same year the coffee trees are planted.

2407 Madiwalar, S.L; Nadagoudar, B.S; Mutanal, S.M. 1996. **Economic evaluation of an agri-silvi-horti-pastoral system in transitional tract of Dharwad**. Proceedings, IUFRO-DNAES International Meeting: Resource inventory techniques to support agroforestry and environment, Chandigarh, 1-3 October 1996: 287-289. S.J. Patil; R.K. Kohli; K.S. Arya; Atul, Eds. HKT Publications, Chandigarh.

Economic analysis indicated that growing of teak, papaya and pasture crops gave higher annual net returns compared with growing only arable crops. Inclusion of teak and papaya with arable crops resulted in the highest average annual net returns.

2408 Maldonado, G; Louppe, D. 1999. **Teak from farmers plantations in Cote d'Ivoire**. (French). Bois et Forests des Tropiques 262: 19-30.

Teak has been planted in rural areas since its introduction in 1929 in Cote d'Ivoire. These plantations are scattered and mostly established on a small scale. The teak plantations provide a significant income for many farmers.

2409 Mathur, A.K. 1951. **The problem of underplanting in teak plantations of Nilambur**. Madras Forest College Magazine 27(3): 132-140.

The problem of raising pure teak plantations is discussed with reference to deciduous habit of teak, soil and rainfall conditions. The experiments in Madras forest department on this problem and underplanting teak with suitable species so as to provide soil cover is discussed. Some species found good for the purpose are listed.

2410 McCrie, C.M. 1908. **Mixed teak forests of Saugor Division, Central Provinces**. Nagpur Forest Officers Conference, Nagpur.

2411 MeCrie, C.M. 1909. **Mixed teak forests of Saugor division and their treatment**. Indian Forester 35(10): 553-560.

The Vindhyan mixed teak forests, its present condition, problems of exploitation and natural regeneration are discussed. The forests are worked under coppice and improvement fellings and the problems of natural regeneration by coppice and seed are discussed.

2412 Milde, R de; Ahmad, I.U. 1985. **The mixed hardwood, teak plantation in Chittagong Hill Tracts**. FAO/UNDP Project BGD/79/017.

2413 Mishra, J; Prasad, U.N. 1980. **Agri-silvicultural studies on raising of oil seeds like *Sesamum indicum* Linn. (til) *Arachys hypogea* Linn. (groundnut) and *Glycine* max Merrill. (soybean) as cash crops in conjunction with *Dalberiga sissoo* Roxb. and *Tectona grandis* Linn.f. at Mandar, Ranchi**. Indian Forester 106(10): 675-695.

Results of a taungya agroforestry project on a clear-felled sal forest site in Bihar are reported. Soil N and P increased after all crops but K decreased. Height of both trees was n.s.d. with and without intercropping.

2414 Misra, K.K; Rai, P.N; Jaiswal, H.R. 1994. **Survival and growth of four tree species inter cropped with wheat-paddy rotation**. Indian Forester 120(8): 745-747.

One-year-old seedlings of *Eucalyptus hybrid* , *Bombax ceiba* and *Tectona grandis* and cuttings of *Populus deltoides* were planted at the Horticulture Research Centre at Pantnagar, Uttar Pradesh. Plots were intercropped with a wheat-paddy rotation. Data are tabulated on tree survival and growth.

2415 Mittelman, A. 2000. **Teak planting by smallholders in Nakhon Sawan, Thailand**. Unasylva 51(201): 62-65.

An agroforestry and community forestry project in Thailand has encouraged small farmers in teak planting.

2416 Mutanal, S.M; Nadagoudar, B.S; Patil, S.J. 2001. **Economic evaluation of an agroforestry system in hill zone of Karnataka**. Indian Journal of Agricultural Sciences 71(3): 163-165.

The results of an experiment involving arable crops, silvicultural trees, horticultural crops and pasture grass, conducted in black clayey soils in Dharwad, Karnataka was used for an economic evaluation.

2417 Mutanal, S.M; Prabhakar, A.S; Nadagoudar, B.S. 2000. **Groundnut (*Arachis hypogaea*)-teak (*Tectona grandis*) interaction in agroforestry system**. Indian Journal of Agricultural Sciences 70(7): 463-465.

In the agroforestry system, light transmission was decreased and the groundnut yield was also decreased. Soil pH and EC decreased with inclusion of teak with groundnut, while available N, P and K increased.

2418 Mutanal, S.M; Prabhakar, A.S; Madiwalar, S.L. 2000. **Growth pattern of groundnut in teak based agroforestry system**. Karnataka Journal of Agricultural Sciences 13(4): 1033-1035.

Taller plants were observed on the western side of teak rows compared with the eastern side of the teak alley. Height reduction was observed in plants that were 1 and 5 m away from teak trees.

2419 Mutanal, S.M; Prabhakar, A.S; Nadagoudar, B.S. 2000. **Growth pattern of sorghum in association with teak based agroforestry systems**. Karnataka Journal of Agricultural Sciences 13(4): 925-927.

An experiment involving sorghum, teak and guinea grass and subabul was initiated in Karnataka to determine the growth pattern of sorghum with teak in agroforestry systems. A significant percentage reduction of plant height was observed in 30, 60, 90 days after sowing and at harvest.

2420 Mutanal, S.M; Prabhakar, A.S. 2000. **Performance of groundnut in teak based agroforestry systems**. Karnataka Journal of Agricultural Sciences 13(4): 919-924.

A long-term field experiment involving groundnuts, teak, guinea grass and subabul was initiated in Karnataka to assess the suitability of groundnut in teak-based agroforestry system. A significant yield reduction resulted when groundnut was intercropped with teak, teak+guinea grass and teak+subabul.

2421 Mutanal, S.M; Prabhakar, A.S; Nadagoudar, B.S. 2001. **Compatability of sorghum (Sorghum bicolor) in teak (*Tectona grandis*)-based agroforestry system**. Indian Journal of Agricultural Sciences 71(3): 197-200.

A field experiment involving teak and pasture crops and subabul was conducted on red gravelly soils in Dharwad, Karnataka to determine the compatibility of associated sorghum. Grain yield was the highest with sole sorghum as compared to sorghum with teak, teak + grass and teak + subabul. Grain and straw yield of sorghum was reduced significantly nearer to the teak valley.

2422 Mutanal, S.M; Prabhakar, A.S; Nadagouda, B.S. 2001. **Performance of teak in silvi agri pastoral system**. Karnataka Journal of Agricultural Sciences 14(1): 179-181.

A field experiment was conducted involving sorghum and groundnut, teak, pasture crops on red gravelly soils in Karnataka to study the performance of teak under different agroforestry systems. Growth of teak was compared based on height, diameter at breast height, basal area and marketable timber.

2423 Mutanal, S.M; Prabhakar, A.S; Nadagoudar, B.S. 2002. **Economic viability of teak based agroforestry system**. Karnataka Journal of Agricultural Sciences 15(3): 543-544.

2424 NABARD. 2002. **Model project on growing teak under farm forestry**. NABARD.

2425 Nadagouda, V.B; Radder, G.D; Patil, C.V; Manjappa, K; Desai, B.K. 1996. **Performance of groundnut in alley cropping under irrigation in north eastern dry zone of Karnataka**. Indian Journal of Soil Conservation 24(2): 132-136.

A field experiment was conducted to study the effect of seven tree species on the associated groundnut crop under irrigation in Karnataka. All the tree species including teak are found to have adverse effect on the pod yield of groundnut.

2426 Nair, P.N. 1980. **Vanalakshmi, an agroforestry project in Kerala**. Indian Forester 106(12): 829-836.

A scheme is described for the introduction of pepper, cocoa and medicinal plants as undercrops in plantations of teak, *Grevillea robusta*, *Bombax* spp. and *Artocarpus hirsutus* in an effort to reduce the loss of forest land to agriculture. Initial results are promising and an internal rate of return of 15 percent is anticipated.

2427 Nakashima, K. 1994. **Development of techniques for the utilization of environmental resources and perspective of promotion of research in the marginal land area 2. Degraded forest lands in the tropics and agroforestry - analysis of light conditions under a canopy of fast-growing trees**. JIRCAS Workshop Papers 2: 4-16.

Light quality and quantity were analysed under tree canopies of about fifty tree species including *Tectona grandis* in order to study its effect on the production of agricultural crops in agroforestry systems.

2428 Ojechomon, O.O. 1963. **Ecological studies on some teak (*Tectona grandis* Linn.f.) planta-**

tions in Nigeria. University Ibadan Botany Studies 5: 18p.

Includes data on the status of the soil under teak and *Cassia stamea* and content of the leaves, stems and litter of teak in ash, N, Ca, and K. The two species are not considered suitable in mixture since their demands on the soil are similar.

2429 OL, J.F. 1909. **Experiences with *Leucaena glauca* - interplanted crop in teak**. (Dutch). Tectona 1: p469.

2430 Osemeobo, G.J. 1989. **An impact and performance evaluation of smallholder participation in tree planting, Nigeria**. Agricultural Systems 29(2): 117-135.

Smallholder participation in afforestation is thought to promote environmental stability, underplanting of food crops, longer fallow periods and short rotations, benefits to the farmer such as domestic supply of wood and additional income and improved wood supply.

2431 Osmaston, L.S. 1907. **The system of agriculture combined with forestry in the Deccan of the Bombay Presidency**. Indian Forester 33(6): 265-273.

Report on experimental line sowings of teak and other tree species along with field crops in the dry parts of Bombay Deccan.

2432 Pandeya, S.C. 1960. **Comparative distribution characteristics of sal and teak in Madhya Pradesh**. Proceedings of the 9th Silvicultural Conference, Dehra Dun, 1956, Part 2: 112-117.

2433 Prahasto, H. 1987. **The influence of taungya systems in teak forest on the social economics of the local community**. Jurnal Penelitian dan Pengembangan Kehutanan 3(2): 8-11.

Analysis of data from Indonesia showed the labour force required in traditional and mass intensification taungya systems, average income and household income of the farmers.

2434 Prasad, R. 1991. **Underplanting of *Stylosanthes* legume crop in teak seed orchards**. Vaniki Sandesh 15(1): 1-5.

Underplanting of *Stylosanthes hamata* in clonal seed orchards of teak at Nepanagar, Madhya Pradesh reduced growth of wild grasses, increased soil fertility and provided good yields of fodder.

2435 Puri, S. 2003. **Are intensive teak plantations in agroforestry practices environmentally and ethicallly sound?** International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

The paper examines the possibilities of growing teak under various agroforestry system, viz., taungya, spatial agroforestry system, silvopastoral system and home gardens. Possibilities of growing some suitable crops and grasses have been examined. How the biophysical factors like light, water, nutrients and root behaviour play a role in increasing tree productivity has been discussed.

2436 Purwanto, R.H; Ito, K; Oohata, S. 2003. **Yields of cash crops in a planted teak forest under agroforestry management in Madiun, East Java, Indonesia**. Forest Research, Kyoto 75: 19-25.

Determined the yields of cassava, maize, rice, groundnut and soyabean which were grown in a planted teak forest in East Java, Indonesia.

2437 Rachadi. 1981. **The intensification of intercropping in forests**. (Indonesian). Duta Rimba 7(50): 18-23.

The silvicultural and socioeconomic advantages of intercropping with food crops in teak forests in Indonesia are described and intensification of its use is advocated.

2438 Rajendran, K; Gunasekaran, T; Devaraj, P. 2003. **Performance of teak (*Tectona grandis* Linn.f.) and rice (*Oryza sativa*) in the agrisilvicultural system in Southern Tamil Nadu**. Range Management and Agroforestry 24(1): 74-76.

Teak trees were planted on the bunds of rice fields and biomass were recorded after ten years of growth. Results indicate that teak can be successfully intercropped with rice under irrigated and rainfed conditions.

2439 Ranasinghe, D.M.S.H.K. 1991. **Agroforestry and community forestry in Sri Lanka**. Sri Lanka Forester 20(1/2): 45-49.

A brief account is given of current agroforestry practices. Systems described include shifting cultivation, taungya in teak plantations, cash cropping systems, intercropping under coconuts and rubber, alley

cropping, conservation farming, farm forestry and silvopastoral systems.

2440 Ranasinghe, D.M.S.H.K; Newman, S.M. 1993. **Agroforestry research and practice in Sri Lanka**. Agroforestry Systems 22(2): 119-130.

A review of agroforestry research and practice in Sri Lanka is given with emphasis on traditional systems, plantation intercropping, silvopastoral systems, fertility improvement and community forestry.

2441 Roder, W; Keoboualapha, B; Manivanh, V. 1995. **Teak (*Tectona grandis*), fruit trees and other perennials used by hill farmers of northern Laos**. Agroforestry Systems 29(1): 47-60.

Surveys and investigations in Luang Prabang Province, Laos shows that farmers preferred teak over fruit trees and coffee because of the better market potential, cash income and wood demand for construction and securing of land tenure. Insufficient financial resources, non-availability of land, lack of seedlings, lack of labour and lack of experience were regarded as the main reasons for not planting teak.

2442 Roosendael, J van. 1927. **Artificial mixing of teak with other trees**. Tectona 20(12): 1003-1020 (Indian Forester 55, 1927: 242-243).

The author describes the different mixtures adopted for different soils. An essay on method of cultivation and mixtures to be adopted on good, mediocre and bad soils is also included.

2443 Roosendael, J van. 1928. **Underplanting trials with Tectona at Krandegen**. (Dutch; English). Tectona 21: 316-333.

Results are presented of different under planting trials undertaken by the author.

2444 Roosendael, J van. 1929. **Mixed cultures of teak and other trees**. Indian Forester 54(4): 242-243.

The paper lists the advantages of mixing teak with other species and recommends optimum mixtures for good medium and poor quality sites.

2445 Roosendael, J van. 1929. **Systematic artificial mixing of teak and other timber species in Java**. Tectona 22: 1015-1033.

2446 Salomon, T. 1911. ***Leucaena glauca* and wedoesan.** Tectona 4: 732-733.

2447 Saravanan, S; George, M; Buvaneswaran, C. 2003. **Cultivation of teak (*Tectona grandis*) in farmland under different agro climatic zones of Tamil Nadu - an analysis of ecological and economic factors**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Ecological factors which favour or limits the growth, yield and timber quality were analysed and results presented. The socio-economic factors for shifting to teak cultivation, from conventional agricultural practices, were analysed and ranked according to Garrett Ranking Technique. The socio-economic profile of teak growing farmers in Tamil Nadu is also depicted. This study confirms that with proper site selection and management practices, teak is one of the best suitable tree species for agroforestry system under short rotation.

2448 Scherr, S.J; Current, D. 1997. **What makes agroforestry profitable for farmers? Evidence from Central America and the Caribbean**. Agroforestry Today 9(4): 10-15.

2449 Sen, N.N. 1965. **Trend of development of forestry in Haldwani, Ramnagar and T and B divisions of Uttar Pradesh during the last 50 years**. Indian Forester 91(3): 158-169.

Describes the techniques of enriching degraded forest by underplanting with teak and other valuable species, the large-scale mechanized planting of quick-growing species.

2450 Shankar, U; Lama, S.D; Bawa, K.S. 1997. **Ecosystem reconstruction through taungya plantations following commercial logging of a dry, mixed deciduous forest in Darjeeling Himalaya**. Forest Ecology and Management 102(2/3): 131-142.

This study examines ecosystem recovery after the conversion of a dry, mixed deciduous forest into a taungya plantation. Planted tree species include *Tectona grandis* with various associate species like agricultural crops.

2451 Shinde, S.R; Ghatge, R.D; Mehetre, S.S. 1999. **Growth and development of sandal wood and its host (*Casuarina*) with teak in mixed plantation**. Indian Journal of Forestry 22(3): 253-256.

An experimental mixed planting of teak and *Casuarina equisetifolia* as host to the

semi-root parasite *Santalum album* was tried at the Agricultural College Farm at Kolhapur in Maharashtra in order to study the suitability of this mixture on marginal soils. It is suggested that the marginal soils of this region can be utilized successfully for mixed plantations of these trees.

2452 Singh, G; Tripathi, S.P. 1998. **Effect of *Eucalyptus tereticornis* shelterbelt on young teak plantation: A case study**. Indian Forester 124(3): 206-210.

Observations made on a teak plantation at Bhavnagar, Gujarat planted along the *Eucalyptus tereticornis* shelterbelt shows that the *E. tereticornis* affected the growth of teak up to a distance of 180 m. and the maximum reduction was observed in the first row of plants. The results suggest that nutrient availability in general and light in particular accounted for the poor growth of teak beneath the shelterbelt canopy.

2453 Siswantoyo. 1981. **Labour opportunities in taungya and other forms of agroforestry**. Observations of agroforestry on Java, Indonesia. Report on an agroforestry course, Gadjah Mada University, Yogyakarta: 62-67. K.F. Wiersum, Ed. Department of Forest Management, Agricultural University, Wageningen, Netherlands.

Reforestation with teak and pine using taungya systems, for soil conservation using small trees as terrace stabilizers, and schemes for erosion control and catchment management on slopes is discussed.

2454 Slinkers, T.L. 1937. **The influence of cutting the interplanting of *Leucaena glauca* in teak plantations**. (Dutch; English). Tectona 30(11): 860-873.

The study of cutting the interplanted *Leucaena glauca* auggested that time and frequency of cutting has no influence on the growth of teak, April cutting is better and cut to limit weed growth, soil drying and wind damage.

2455 Smith, R. 1977. **Gap planting of *Tectona grandis* in logged mixed dipterocarp forest: Interim report**. Forest Department, Sarawak, Forest Research Report 17: 16p.

Teak seedlings were planted in logging gaps in the Niah Forest Reserve. Six months after planting, average mortality and height increment were noted.

2456 Soekartiko, B. 1980. **Experiences with intensified taungya on forest lands**. (Indonesian). Indonesia, Gadjah Mada University, Forestry Faculty:- Experiences with agroforestry on Java, Indonesia:-Pengalaman dengan agroforestry di Jawa, Indonesia: 141-158. Fakultas Kehutanan, Universitas Gadjah Mada, Yogyakarta, Indonesia.

A detailed account of the system of intensified taungya successfully applied in the Banyumas-Barat forest district of Java is given.

2457 Soekeri. 1980. **Mix cropping between teak and lac tree (*Schleichera oleosa*)**. (Indonesian). Gema Rimba 6(41/42): 39-45.

2458 Soemarwanto, O. 1982. **Cultivation pattern research at 1980/1981 teak intercropping plantations**. (Indonesian). Duta Rimba 8(56): 11-13.

Taungya trials with rice, maize, soyabean and small green peas, Gajah and peanuts and other food crops are reported.

2459 Sujatha, M.P; Jose, A.I; Sankar, S. 2001. **Reed underplanting in older teak plantations: A healthy soil management practice**. Tropical Forestry Research: Challenges in the New Millennium. Proceedings of the International Symposium, Peechi, India, 2-4 August 2000. R.V. Varma; K.V. Bhat; E.M. Muralidharan; J.K. Sharma, Eds: 168-170. Kerala Forest Research Institute, Peechi.

Indicate that the health of soil with respect to erosion status, structure, alluvial clay, bulk density, water holding capacity and organic carbon was significantly better in teak with reed as undergrowth than without it.

2460 Sunderlin, W; Sullivan, G.M; Huke, S.M; Fox, J.M (Eds). 1992. **Benefits, costs, and equity: Analysis of a social forestry site in Central Java**. Financial and economic analyses of agroforestry systems: Proceedings of a Workshop, Honolulu, Hawaii, USA, July 1991: 261-270. Nitrogen Fixing Tree Association, Paia, USA.

Java Social Forestry Programme managed by the State Forestry Corporation of Indonesia assigned the degraded forest land to participating households for use as forest farm land, on which both crops and teak forests are raised. Results of the analysis of data from such a social forestry site is presented.

2461 Sutherland, S. 1993. **Performance of *Tectona grandis* in live fences in Panama**. Enlace Madelena 3(2): 1; 4-5. Centro Agronomico

Tropical de Investigacion y Ensenanza, Turrialba, Costa Rica.

2462 Sweet, J.M. 1923. ***Artocarpus hirsuta* as an underwood for teak**. Indian Forester 49(5): 248-251p.

Attempts on underplanting and recommends its introduction in teak plantations just before 2nd or 3rd thinning to suppress epicormic branches are described.

2463 Tee, B; Paterl, F; Chiew, A. 1995. **Teak in Sabah - a sustainable agroforestry**. Sejati Sdn Bhd, Sabha, Malaysia: 77p.

2464 Teyadhiti, M; Vimuktalob, C. 1992. **Feasibility study on agrosilvicultural system involving teak by the farmer**. Proceedings of the Seminar on 50 Anniversary of Huay-Tak Teak Plantation, Thailand, 5-8 August 1992.

Study finds that an intensive cultivation of teak together with field crops will yield high economic return and generate farm income of the farmers during the time teak trees are approaching the felling stage.

2465 Tobi, E. 1909. **Interplanting of *Leucaena glauca***. Tectona 1: p603.

2466 Venkataramany, P. 1956. **Underplanting in teak plantations in Madras State**. Indian Forester 82(5): 225-236.

Reviews the results of some small scale experiments in underplanting teak plantations and concludes that underplanting of pure even-aged teak with bamboo or tree species will reduce volume increment of teak.

2467 Venkatesh, C.S. 1974. **Teak versus semal- A dialogue in the forest**. Indian Forester 104(7): p479.

Characters of the two species from the point of utility, biological characters and breeding feasibility are discussed.

2468 Verinumbe, I; Okali, D.U.U. 1985. **The effect of coppiced teak regrowth on soil in a teak-maize agroforest**. Forest Ecology and Management 12(1): 37-41.

The effects on soil and roots of coppiced teak regrowth in a maize-teak mixture in Nigeria were investigated and suggested that soil nutrient changes due to canopy or surface roots of coppiced teak regrowth are too small to influence the performance of intercropped maize in the first season following coppicing.

2469 Verinumbe, I; Okali, D.U.U. 1985. **The influence of coppiced teak (*Tectona grandis* Linn.f.) regrowth and roots on intercropped maize (*Zea mays* L.)**. Agroforestry Systems 3(4): 381-386.

Results showed that competition for light was more important than root competition in reducing the yield from the maize.

2470 Voogd, C.N.A de. 1928. **Artificial mixing of teak and other timber species**. (Dutch; German). Tectona 21: 527-533; Forest Rundschan, Indonesia 1: p348.

2471 Walker, H.C. 1912. **Teak and bamboo in Burma**. Indian Forester 38(12): 583-599.

Experimental data on growth of teak with special reference to bamboo flowering is presented.

2472 Watanabe, H; Sahunalu, P; Khemnark, C. 1988 . **Combinations of trees and crops in the taungya method as applied in Thailand**. Agroforestry Systems 6(2): 169-177.

The paper describes the crop combinations used to rehabilitate waste land in Thailand. The major combinations included teak with upland rice, maize or sorghum.

2473 Watson, G.A. 1980. **Tree intercropping possibilities**. Proceedings of the Agricultural Sector Symposium, 7-11 January 1980: 139-159. World Bank, Washington DC, USA.

Include the description of the taungya system with teak planting. Possible developments in the taungya system are briefly discussed.

2474 Wepf, W. 1955. **Mixing in teak plantations**. (Dutch; English). Tectona 43: 290-294.

2475 Wesley, D.G. 1964. **Accelerated forestry**. Myforest 1(3): 28-26.

Trials of eucalypt - teak mixtures in Mysore state proved satisfactory.

2476 Willemsen, J.W. 1911. ***Leucaena glauca***. Tectona 3: p170.

2477 Win, S; Kumazaki, M. 1998 . **The history of taungya plantation forestry and its rise and fall in the Tharrawaddy Forest Division of Myanmar (1869-1994)**. Journal of Forest Planning 4(1): 17-26.

The taungya system is believed to have originated in the Tharrawaddy Forest Division of Myanmar and was devised by Dr. Dietrich Brandis after observing the taungya practices of the Karen hill people. Taungya teak plantations expanded in the Tharrawaddy Forest Division from 1869, as teak grows well in this area and the facilities for teak timber extraction are good.

2478 Wongsakulwiwatana, S; Manmuang, S; Anekkana, S. 1979. **Growth study of teak in enrichment plantation with and without interplanting field group**. (Thai). Report on Silviculture 1977-1978. Royal Forest Department, Ministry of Agriculture and Cooperatives, Bangkok.

2479 Yadav, R.S; Ram, M; Solanki, K.R; Kareemulla, K; Singh, R. 2003. **Economic evaluation of agri silviculture under irrigated condition in Bundelkhand Region of India**. Indian Journal of Soil Conservation 31(2): 210-213.

Black gram and wheat were grown intercropped between teak, neem and *Albizia procera* and evaluated the yield of the crops.

2480 Yingransiri, T; Sumantakul, V. 1979. **Mixed cultivation of teak (*Tectona grandis* Linn.f.) with *Pinus* spp**. (Thai). Report on Silviculture 1977-78: 76-77. Royal Forest Department, Ministry of Agriculture and Cooperatives, Bangkok.

2481 Zachariah, P.K. 1997. **Teak and taungya with particular reference to biotic and environmental factors**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 253-258. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

The taungya system was introduced first in 1915, in a teak plantation in Konni Forest Division. In 1986, the government banned the taungya in forest plantations as various ill effects of taungya in teak plantations have been projected by researchers. Reintroduction of taungya plantations in smaller extent with proper modification of the system is proposed.

2482 Zeng, B.S; Yin, G.T; Xu, H.C; Liu, Y; Feng, C.L; Lu, S.A. 2003. **Afforestation of *Calamus simplicifolius* by tube-seedlings**. (Chinese). Forest Research, Beijing 16(2): 240-244.

The survival rate of tube-seedlings planted in different areas including teak forests is reported as more than 90 percent.

Go top

Harvesting

(See also 0375, 0530)

2483 **Extract from Madras Athenoeum**. Indian Forester 10, 1884: 318-319.

The price of teak wood from Burma was compared and the price was almost doubled due to great demand in far-eastern markets especially Australia.

2484 **Improvement fellings for the benefit of teak in Burma**. Indian Forester 25(8), 1899: 320-323.

With reference of Mr. Nisbet's note on improvement fellings in fire protected areas, with reference to prevailing teak forests of Burma, current methods of teak regeneration, artificially and by taungyas are critically examined and reviewed.

2485 **Extraction of teak timber in the Pyinmana forest division, upper Burma**. Indian Forester 38(4), 1912: 151-154.

2486 **Optimization of the level of mechanization of logging in teak (*Tectona grandis*) forest on Java using the isoquant method of Sundberg**. Duta Rimba 129/130, 1991: 16-20.

2487 Adu Anning, C; Blay, D Jr. 2001. **Ensuring sustainable harvesting of wood: Impact of biomass harvesting on the nutrient stores of teak woodlot stand in the Sudan Savanna**. Ghana Journal of Forestry 10: 17-25.

2488 Arifin, Z; Surjokusumo, S. 1974. **The transport of teak (*Tectona grandis*) by railway in Java**. Laporan, Lembaga Penelitian Hasil Hutan 36: 23p.

Reports an investigation of the methods of construction, maintenance and operation of light railways which have a variety of gauges and rail sizes. Time studies of log transport with manual or locomotive traction are included.

2489 Bake, H.W.A van den Wall. 1908. **The exploitation of teak forests of Java**. (Indonesian). Indische Mercur 31(8): p129.

2490 Banijbhatana, D. 1953. **The departmental working of forests in Thailand**. The Royal Forestry Department Bulletin 4.

As the exploitation proved to be of great benefit to the welfare of forests as well as to the national economy, more teak forests were taken up for departmental working. The forest industry organization was established and managing three big saw mills of Bangkok and a plywood mill is also planned for installation .

2491 Basari, Z; Ishak, S. 1997. **Harvesting system in teak forest in Java**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 73-75. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

In Java, conventional logging system is still practiced in teak forests due to various socio-economic reasons. To improve the social condition of the forest labourers, Perum Perhutani has built up resettlement called Magersaren near the forest. Various aspects of felling operations including non-technical preparation, operational felling and utilization of Tirfor are discussed.

2492 Becking, W; Becking, J.H. 1919. **The exploitation of teak thinnings**. Tectona 12: 1-63.

2493 Bellers, H. 1925. **Chronological survey of the keeping of the exploitation in the teak forests of the department in the residency of Djokdjakarta**. (Indonesian; English). Tectona 15: 355-400.

2494 Brascamp, E.H.B. 1921. **Teak exploitation in Pangesana in 1728 & 1729, in Kolonial Archief No. XXVII**. Tectona 14(2): 998-1020.

2495 Butterwick, A.J. 1919. **Girdling of teak trees in Burma**. Indian Forester 45(12): 65-67.

Discusses the width of the cut to be given for effective girdling.

2496 Cermac, F. 1957. **The pure teak stands of Java and their utilization**. (German). Schweizerische Zeitschrift Fur. Forstwesen 108(3): 175-188.

A general account of the natural and planted teak forests, their management, establishment and yield, logging, transport and primary conversion and utilization including mill equipment is given from the author's own experience.

2497 Classen, J.C van R. 1915. **Cutting cycle**. (Indonesian; English). Tectona 8: 109-114.

A general article on rotation of teak.

2498 Coster, C. 1930. **Observations on girdling of teak (*T. grandis* L.f.)**. (Dutch; English). Tectona 23: 166-182.

The present study indicates that shrinkage, swelling, or physical properties of wood are not effected by length of period of girdling.

2499 Coster, C. 1930. **On the influence of girdling on the properties of teakwood more specifically on its cleaving**. (Dutch; English). Meded Proefsta Boschw 18: 98-199.

An investigation made to test the traditional impression that by girdling teak two years in advance of felling, cracking of wood is prevented and conversion of larger sized teak is greatly facilitated.

2500 Coster, C. 1931. **Influence of girdling on Java teak**. Empire Forestry Journal 10: p148.

2501 Decamps, A. 1955. **Teak logging in Siam**. (French). Bois et Forests des Tropiques 42: 26-36 .

Describes the use of girdling, felling methods, the employment of elephants for skidding logs to the launching place, and the process of floating and rafting to the mills. The advantages of employing elephants rather than tractors are emphasized.

2502 Deventer, A.J van. 1910. **About clearing of natural teak forests in Nogmaals-1909**. (Dutch; English). Tectona 2(1): 22-30.

2503 Deventer, A.J van. 1914. **Further observations on the cutting cycle and the regulation of operations in the teak forests in Java**. (Dutch; English). Tectona 7: 721-747.

2504 Dijkmans, M.A.F. 1931. **Clear cutting in Tectona plantations**. Tectona 24: 141-202.

2505 Dijkmans, M.A.F. 1931. **Discussions on clearcutting in *Tectona***. Tectona 24: 424-450.

2506 Doorn, A van. 1924. **The need for rails and rail-roads in teak forests in Java**. Tectona 17: 676-685.

2507 Doorn, Z van. 1931. **Mechinale verzaging De Nieuwe phase in de ontwikkeling van de edploitatic in Eighen Beheer Deer Djatiboschen op. Java**. Tectona 24: 1-38.

Mechanical treatment in the new phase of development in the exploitation of the departmental business of teak in Java.

2508 Dulsalam. 1990. **The effects of slope and load volumes on the productivity of a hand cart in teak forests**. (Indonesian). Jurnal Penelitian Hasil Hutan 7(1): 8-11.

Data are reported from a work study in teak forest in East Java, in which the effects of four slopes and four load volumes were tested on the productivity of log hauling using a hand cart.

2509 Ellis, E.V. 1912. **Department teak extraction in the Zigon division, Burma**. Indian Forester 38(1): 18-27.

2510 Endom, W. 1997. **Log split in teak felling operation**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 76-80. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

This preliminary study was carried out to develop a practical, simple and cheap equipment to reduce log split during felling operation.

2511 Gajaseni, J; Jordan, C.F. 1990. **Decline of teak yield in northern Thailand: Effects of selective logging on forest structure**. Biotropica 22(2): 114-118.

The decrease in yield has been attributed to loss of trees for shifting cultivation and intensive agriculture. Because of over exploitation of large trees, profitable yield will not be possible.

2512 Garcia, C.J.R. 1973. **Application of intermediate fellings in plots of *Tectona grandis* in Araure-Acarigua, Venezuela**. (Spanish). Revista Forestal Venezolana 16(23): 67-82.

Effects of thinning have been studied. The nine experimental plots differed in spacing and in frequency of thinning. Data on the mean annual increments in height, basal area and volume are tabulated.

2513 Hai, Hato. 1917. **Commercial vs. quasi commercial departmental teak extraction in Burma**. Indian Forester 43(3): 111-116.

The author examines the problems of commercial working and suggests recruiting special timber working staff on a commercial basis without administrative duties and technical training.

2514 Hole, R.S. 1916. **Teak reproduction as a result of clear felling**. Indian Forester 42(2): 51-57.

Describes an experiment on the effect of shade and admixture of dead teak leaves in the soil on the germination of teak. Results indicated germination is better and admixture of dead leaves material improved both percentage of germination and also vigour of young plants.

2515 Idris, M.M; Basari, Z; Soenarno. 1986. **Effectiveness of using tirfor and lever block on teak felling in Central Java**. (Indonesian). Jurnal Penelitian Hasil Hutan 2(4): 8-13.

2516 Idris, M.M; Soenarno. 1990. **Mechanization of teak felling in order to reduce dependence on a limited forest labour supply in Java**. (Indonesian). Jurnal Penelitian Hasil Hutan 6(8): 471-476.

A study was conducted in Central Java in which the productivity of three felling systems of mechanized, manual, and the combination of the two was compared on teak. Productivity was better in the case of mechanised felling.

2517 Idris, M.M; Suhartana, S. 1987. **The effect of calorie intake on the performance of teak loggers in Jombang Forest District**. Jurnal Penelitian Hasil Hutan 4(3): 17-20.

Average productive working hours of teak fellers in Jombang District, Indonesia, were analysed for different age groups and eating frequencies.

2518 Idris, M.M; Tjarmat, E; Sastrodimedjo, R.S. 1982. **Effectiveness of Tirfor to reduce wood damage in teak felling**. (Indonesian). Laporan, Balai Penelitian Hasil Hutan, Indonesia 160: 17-22.

A description is given of trials with the Tirfor winch designed to control the direction of tree fall. Regression equations are given that related diameter and slope to damage.

2519 Jouvanceau, J; Lepitre, C. **Mechanized extraction of teak poles in Dahomey**. (French). Bois et Forests des Tropiques 87: 35-48.

Bundles of logs are skidded by means of a 35-h.p. agricultural tractor equipped with a winch in front and an A-frame at the rear as with an arch. Costs and efficiency of this method are compared in detail with those of hand skidding.

2520 Kammesheidt, L; Franco, W; Plonczak, M. 2001. **History of logging and silvicultural treatments in the western Venezuelan plain forests and the prospect for sustainable forest management**. Forest Ecology and Management 148(1/3): 1-20.

2521 Keddy, C.V.K. 1967. **Saving in wood by felling with saw**. Indian Forester 93(4): 258-263.

A study was made to ascertain the amount of wood wasted by axe felling for trees of several girth classes and consequent financial loss. An advantage of felling by saw is that it is not necessary to trim the stumps to encourage coppicing as is done after axe felling.

2522 Kools, J.F. 1976. **Historical view of the utilization of the railway in the teak forest area**. (Indonesian). Kehutanan, Indonesia (Forestry in Indonesia) 3(10): 263-268.

2523 Lindgren, P. 1986. **A handbook on basic logging and transport methods adapted to typical conditions in India**. 128p. Forskningsstiftelsen Skogsarbeten, Spanga, Sweden.

Logging and transport systems using gravity, men, draught animals, farm tractors and trucks are covered. Seven case studies of Orissa, Maharashtra and Jammu-Kashmir are made. The case studies include selective thinning in plantations of teak also. Based upon these studies, suitable methods, tools and equipment are recommended.

2524 Maman, M.I; Zakaria, B. 1985. **Effectiveness of using tirfor and lever block of teak felling in Central Java**. Forest Products Research and Development Centre, Bogor, Jakarta.

2525 Mangundikoro, A. 1974. **A costing system for teak forest logging in Java**. Laporan, Lembaga Penelitian Hasil Hutan 34: 26p.

Describes an improved cost accounting system for the Indonesian state forest enterprise Perhutani in the *Tectona grandis* forests. The system enables the unit product cost of the separate products of logs, squares, and fuelwood.

2526 Masuko, H. 1987. **Illicit felling in Thailand**. (Japanese). Tropical Forestry 9: 32-39.

Estimates of illicit felling of teak in Thailand. Examples of illicit felling and its effects and the comments of local newspapers are described.

2527 Miedler, K.A. 1957. **Report to the Government of Burma on mechanization of teak extraction**. Expanded Technical Assistance Program, FAO, Rome. FAO Report 614: 53p.

Describes an experimental extraction unit.

2528 Mitra, S.K; Sood, K.G. 1980. **Timber transportation - a comparative study**. Indian Forester 106(8): 533-544.

A study was made of the timing and the cost of transporting teak logs.

2529 Narayanamurti, D; Prasad, B.N; Singh, K. 1963. **Temperature changes in woodworking tools**. Norsk Skogind 17(9): 357-358.

Some results of trials, in which thermocouple was used to measure the temperature during wood turning.

2530 Nisbet, J. 1899. **Note on improvement fellings for the benefit of teak in fire protected reserved forests**. Indian Forester 25(5): 202-214.

A note on improvement fellings in the fire-protected reserved teak forests. Notes of Inspection and observations are described in detail.

2531 Pahlitzsca, G; Schulz, K. 1957. **Planning with rotary cutters: Measuring the cutting force and edge-wear**. Holz als Roh-und Werkstoff 15(4): 159-170.

A new method and experimental apparatus are described and results of experiments are presented.

2532 Predjorahardjo. 1990. **Analysis of teak forest age classes in Perum Perhutani Unit II East Java**. (English; Indonesian). Duta Rimba 16(121/122): 3-13.

Age class analyses are given for the teak forests of East Java. The area of each class tends to decrease with time because of clear felling in mature stands and damage in young stands. The effects of felling cycle and felling age for sustained yield are discussed.

2533 Rand, C. 1959. **Work animals of the orient**. Natural History 68(7): 384-399.

Deals with use of elephants for teak logging in India.

2534 Rao, D.S; Singh, B.P. 1991. **Wastage of timber at tree harvesting stage in South India**. Indian Forester 117(8): 609-617.

Observations were made at sites in Andhra Pradesh, Karnataka, Tamil Nadu and Kerala on the extent of wastage during various logging operations. It is suggested that reduction of wastage can be achieved by use of the proper tools, proper tool maintenance and proper training.

2535 Rodger, A. 1915. **Teak floating in the lower Burma in the dry weather**. Indian Forester 41(9): p2.

The problems of teak floating are discussed and suggestions are made for clearing the river beds.

2536 Sagreiya, K.P. 1939. **The efficiency of irregular stocking paper VIII. The efficiency of irregular stocking with special reference to the Central Provinces forests**. Proceedings of the 5th Silvicultural Conference, Dehra Dun, 1939, 8: 192-195. Forest Research Institute, Dehra Dun.

2537 Singhal, R.M. 1949. **Timber floating in Godavari, Indravati and Pranhita Rivers**. Indian Forester 75(8): 300-301.

2538 Sivarajan, M. 1963. **The first harvest of mature teak plantation in Thenmala Forest Division**. Keralaranyan: 66-68.

Gives the history of teak plantation in Thenmala Forest Division of Kerala state.

2539 Soenarno; Mansyur, M. 1990. **The effect of improved felling system in various field topographies on the quality of teak wood products**. (Indonesian). Duta Rimba 16(121/122): 14-19.

Data are presented on the percentage of quality teak obtained from mechanized and manual felling and from a combination of both types of felling, in flat and hilly terrain in Central Java.

2540 Soenarso, S. 1978. **Guidance operational handsaw technique on teak forest**. Forest Research and Development, Bogor.

2541 Soenarso, S; Ishak, S. 1979. **The improvement of felling technique in Java**. Ergonomics in tropical agriculture and forestry: 132-133. PUDOC, Wageningen, Netherlands.

In teak logging operations, need of improvement in felling and saw maintenance is suggested.

2542 Soernnggabjiwa, M.H. 1964. **Evaluation of the current method of allowable cut determination in teak forests**. (Indonesian). Rimba Indonesia 9(1): 41-54.

The method of calculating the allowable cut in teak forests of Indonesia based on actual wood volume of over mature stands plus that of immature stands at rotational age and rotation is described and discussed other methods and compared with Von-Montal's method.

2543 Soeters, K. 1917. **Clear cutting in secondary teak crops**. Tectona 10: 927-943.

2544 Soewito; Sastrodimedjo, R.S; Wirapradja, A. 1975. **Situation of forest worker supply in Java**. (Indonesian). Laporan, Lembaga Penelitian Hasil Hutan 51: 16p.

Reports a sample survey of workers interviewed at 42 forest-exploitation sites in Indonesia.

2545 Srisook, P. 1962. **A merchantable logging of teak in Lampang**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Data of the expenditure for extraction is given.

2546 Suhartana, S; Idris, M.M. 1990. **Anthropometric data from teak loggers in Bandungsari sub-forest district - Purwodadi forest district, central Java**. (Indonesian). Jurnal Penelitian Hasil Hutan 71: 28-33.

Anthropometric measurements were reported for teak loggers, as part of an ergonomic study.

2547 Sukwathana, P. 1963. **Capital cost of extraction of teak by the forest industry organization in Prac Province**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Costs of teak extraction is given.

2548 Sumantri, I. 1983. **Use of Tirfor for felling activity in teak**. (Indonesian). Laporan, Pusat Penelitian dan Pengembangan Hasil Hutan, Indonesia 169: 17-27.

Investigated the wood damage by the use of the Tirfor winch and compared with the use of a handsaw. The Tirfor needed more man-hours than the handsaw.

2549 Tattiemromya, P. 1958. **Teak stealing**. (Thai). Vanasarn 16(2): 11-17.

Four methods of irregular cutting and smuggling of teak in Thailand are described and measures to arrest it are discussed.

2550 Thephasdin, M. 1970. **Teak in the forest insistently deteriorated by means of getting**

away with forest law. (Thai). Vanasarn 28(3): 290-295.

The present forest law is considered not very strict. The author also discusses the socio-economic problem of people in the Northern region of Thailand who are depending on illegal cutting of forests.

2551 Troup, R.S. 1910. **Memorandum regarding prescriptions for improvement fellings in teak working plans in Burma and the introduction of a more uniform system of working**. Indian Forester 35(10): 583-595.

Discusses the present prescriptions in the working plans of teak forests of Burma and suggests a more uniform system of working and various operations to be carried out for obtaining uniform stocking. The details of girdling, extraction and improvement felling are described and also proposals for cleaning and thinnings in the plantations are given.

2552 Wanakich, L.P. 1952. **A short note on teak timbers stealing in the forests of Northern Thailand**. (Indonesian). Vanasarn 10(2): 41-45.

The measures adopted by the forestry service to arrest illegal cutting of timber in the northern part of Thailand are described.

2553 Wartono Kadri; Soewito; Hasan Muharam, E. 1970. **Experience in research on skidding with draught cattle at Tjepu forest district**. (Indonesian). Laporan, Lembaga Penelitian Kehutanan 113: 27p.

Describes a traditional technique for extracting teak logs, including the use of pulleys to increase traction and reports results of a work study on the use of 1-5 pairs of animals yoked together, in order to increase efficiency without losing traditional skills.

2554 Westra, J.G. 1922. **Results with the K. Stump puller in the teak forest district Gedangan (Java) in 1921-22**. (Dutch; English). Tectona 15: 1111-1116.

Advantage of pulling the trees with the K-stump-puller is dealt with.

2555 Wroughton, F.H. 1940. **Burma teak and its extraction**. Journal of South African Forestry Association 5: 5-9.

An account of the wood, the country in which the tree is found, and the method of its extraction, with particular reference to the use of elephants in this work are dealt with.

2556 Zwart, W. 1938. **Cost of cutting and extraction of departmentally worked teak at Tjepoe**. (Dutch). Tectona 31(3): 149-161.

Data is given of the cost of extraction of teak.

Go top

Injuries and Protection

2557 **Control method for stem division in teak forests**. (Indonesian). Majalah Kehutanan Indonesia 12, 1983: 24-26.

2558 Browne, F.G. 1968. **Pest and diseases of forest plantation trees**. 1330p. Clarendon Press, Oxford.

2559 Chalermpongse, A; Boonthavikoon, T; Chairuangsirikul, T. 1990. **Surveillance of disease and insect damage of teak plantations in Thailand**. Proceedings of IUFRO Workshop on Pests and Diseases of Forest Plantations, Bangkok, 5-11 June 1988: 224-235. C. Hutacharern; K.G. MacDicken; M.H. Ivory; K.S.S. Nair, Eds.

2560 Deventer, A.J van. 1911. **Protection of Tectona forests against wind**. (Dutch; English). Tectona 4: 561-572.

2561 Forest Research Institute, Dehra Dun. 1928. **Mortality of teak trees in thinned and unthinned plantations**. Forest Research in India, Forest Research Institute, Dehra Dun: p23.

2562 Forest Research Institute, Dehra Dun. 1953. **Mortality of sal and teak in Gorakhpur Division**. Forest Research in India Part I (1952-53): p75.

The mortality of teak trees observed in Pharenda range is tentatively attributed to drought and severe damage to the bark by the termite *Odontotermes parvidens* Holmg and Holmg.

2563 Forest Research Institute, Dehra Dun. 1954. **Mortality of teak in Mandvi range**. Forest Research in India Part II 1953-54: 23-24.

Heavy mortality of teak observed is attributed to prolonged drought and the continuous working of the forests.

2564 Forest Research Institute, Dehra Dun. 1961. **Mortality in forest species (sal, casuarina, teak, spruce etc)**. Proceedings of the 10th

Silvicultural Conference, Dehra Dun: 774-784.

The causes of mortality of teak and other species are discussed.

2565 Hadipoernomo. 1978. **The problem of wood thefts in the teak forests**. (English; Indonesian). Duta Rimba 4(27): 20-25.

2566 Hadipoernomo. 1981. ***Acacia arabica* as a hedge crop**. (Indonesian). Duta Rimba 7(46): 13-15.

The use of the multipurpose species *A. arabica* as a thorny hedge round teak forests in Indonesia is described for the prevention of cattle penetration.

2567 Jamaluddin. 2003. **Tree health of teak in central part of India**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Teak is prone to be damaged by a number of fungal pathogens affecting seed, root diseases, stem and branch canker and die back, collar rot, heart rot in dry coppice teak and mortality in natural teak forests. Bacterial diseases in nursery and plantations also caused considerable losses. Some of the established control/managements tactics were also described.

2568 Jha, M. 1995. **Mortality in pure teak plantation**. Indian Forester 121(6): 576-577.

Mortality of teak plantation in Maharashtra is reported. Mortality is attributed to drought and damage by termites.

2569 Kalshoven, L.G.E. 1928. **Teak forests in Java as affected by injuries, diseases and pests**. (Dutch; English). Tectona 21: 593-623.

A review on various diseases, insect pests, damages and injuries caused to teak forests.

2570 Kotwal, E.K. 1959. **Teak in Bombay-some problems**. Proceedings of All-India Teak Study Tour and Symposium, December 1957 to January 1958: 157-158.

Discusses the damage to teak forests and plantations of Bombay due to injuries and *Loranthus* attack. Black cotton soils cause heavy mortality after middle age due to water logging, in addition to developing fluting and forking defects.

2571 McDonald, T. 1940. **Bori Reserve, 1859-1940** . Indian Forester 66: 529-543.

A historical review of the teak forests of Bori Reserve, in the Central Provinces of India. These forests were the first in India to be reserved and fire protection was practised probably earlier than in any other-part of the tropics.

2572 Pinzon Florian, O.P; Moreno Beltran, H. 1999. **Phytosanitary problems of *Tectona grandis* and *Gmelina arborea*: An overview**. Boletin de Proteccion Forestal 4: 11-16. Corporacion Nacional de Investigacion y Fomento Forestal, Colombia.

An overview of insect pests and plant pathogens occurring on teak and *Gmelina arborea*, with special attention to potential problems in Central America.

2573 Prasad, R; Jamaluddin. 1989. **Observations on the problem of teak mortality in central India**. Journal of Tropical Forestry 5: 72-75.

Go top

Drought, Pollution and Growth Stress

2574 **Damage to teak by drought in the Panch Mahals of Bombay Presidencey**. Indian Forester 29(7), 1903: 263-266; 31, 1905: p686.

Drought in the division has killed or damaged nearly 45 percentage of standing trees and in some forests 90 percentage affected and causes of death due to soil and critical moisture depth are examined.

2575 Bakshi, B.K; Boyce, J.S. 1959. **Water blister in teak**. Indian Forester 85(10): 589-591.

Water blister disease in teak is noted in certain plantations along rivers in Nilambur, Kerala. It is characterized by profuse exudation of light yellow sap from stem near ground level. It is suggested not to plant teak on very moist sites where water blister develops.

2576 Catinot, R. 1970. **Defects of stem form in teak in Dahomey, and a theory to explain their origin**. (French). Bois et Forests des Tropiques 132: 3-22.

Many stems in teak plantations established in Dahomey contain lumps and flutes and is attributed to the marginal rainfall, the occurrence of a short dry season at flowering time and inadequate rooting in some leached soils.

2577 Fischer, C.E.C. 1914. **Stone found in heart of a teak tree**. Indian Forester 40(7): p372.

The chemical composition of a concretionary stone found in the heart of a teak tree extracted from Tekkadi forests of South Coimbatore is given.

2578 Gueneau, P; Chardin, A. 1973. **Growth stresses**. (French; English). Cahiers Scientifiques, Centre Technique Forestier Tropical 3: 52p.

2579 Kallarackal, J; Bhat, K.V; Seethalakshmi, K.K. 1997. **Water blister problem of teak in Kerala**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 124-128. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

An investigation was undertaken to study the possible causes for development of water blister, and the nature and extent of the resultant damage to the timber.

2580 Kallarackal, J; Seethalakshmi, K.K; Bhat, K.V. 1992. **Water blisters in teak**. KFRI Research Report 82: 22p. Kerala Forest Research Institute, Peechi, Trichur.

Studies are reported on occurrence, symptoms and damage caused to the wood of teak trees at several sites in Kerala by water blisters.

2581 Kubler, H. 1987. **Growth stress in trees and related wood properties**. Forestry Abstracts: 131-189.

2582 Kulkarni, H.D; Dharmaswamy, S.S; Srimathi, R.A. 1987 . **Peculiar trees of teak at Nilambur, Kerala**. Myforest 23(2): 75-76.

Reported the three types of peculiarities observed in 30-141 yr old plantations. The peculiarities were pits, regular undulating swellings over the length of the bole and irregular bulging caused by false knots from epicormic buds.

2583 Narayanamurti, D; Gupta, R.C. 1961. **Swelling pressure of wood**. (German; English). Journal Japanese Society for Testing Materials 10(92): 434-438.

Results of the tests made on about eighty species of Indian woods including teak were presented. Test methods and equipment were described.

2584 Narayanamurti, D; Jain, N.C; Gupta, R.C. 1963. **Growth stresses in trees**. (English; German; French). Silvae Genetica 12(3): 89-99.

Presents the results of experiments on discs of teak showing water-blister symptoms.

2585 Rosso, F; Ninin, P. 1998. **Variability of log defects in teak (*Tectona grandis* Linn.f.) growing at different densities in the Experimental Unit of Ticoporo Forest Reserve, Barinas, Venezuela**. (Spanish). Revista Forestal Venezolana 42(2): 103-112.

Frequency of knots, eccentricity, flattening and bowing were studied in relation to diameter class and stem height for different densities of trees.

2586 Suwanwaree, P. 1994. **Effects of sulfur dioxide on sulphur accumulation and anatomical change of plants on high terrain or Mae Moh's project area, Changwat, Lampang**. Kasetsart University, Bangkok: 113 leaves.

Higher sulfur content in plants was appeared in rainy season while lower content was detected in dry season. Leaf tissue accumulated sulfur more than stem tissue. Plants adapted themselves by increasing in size of upper and lower epidermal cells, palisade cells, spong cell layer and guard cell number of leaf and sulphur content in both leaf and stem tissue significantly.

2587 Wolff von Wulfing, H.E. 1923. **Damage to the trunks of young teak (*Tectona grandis* Linn.f.) caused by tearing off of branches**. Tectona 16(7): 628-635; Korte Meded Proefsta Boschw 5: 8p.

Teak leaves used for wrapping caused damage either by direct picking or by tearing of small branches, at the beginning of wet monsoon. This causes appreciable damage to the trunks, and the paper describes some forms of damage.

2588 Zwart, W. 1938. **The distribution of knotty teak**. Tectona 31: 927-928.

Go top

Forest Fire

2589 **Fire protection in teak forests of Burma**. Indian Forester 30(9), 1904: 414-419.

2590 **Fire protection in teak forests of Burma-1**. Indian Forester 30(11), 1904: 514-515.

2591 **A summary of the observed results of fire protection in teak forests**. Indian Forester 31(8), 1905: 421-424.

The experience in the past and observations made on fire protection are summarised. Fire remove heavy covering of leaves and herbaceous growth, hastens germination, enhance more vigorous growth and suppression of poles and saplings.

2592 **Fire protection in the teak forests of Burma-II**. Indian Forester 31(3): 146-147; 31(4), 1905: 208-211.

Discussing the general view that fire protection is harmful to natural regeneration, the author advocates controlling and use of fire for establishing already existing natural regeneration of teak in Burma.

2593 Altona, T. 1926. **Kangkoengan *Ipomea carnea* and its value to make fire protecting strips around teak plantation**. (Indonesian; English). Tectona 19: 124-134.

The plant is suited for the purpose of fire protection around teak plantation.

2594 Ansep, T.T. 1925. **Effect of firing young teak**. Indian Forester 51(1): 46-47.

Reports an experiment in Chikkanji North, Malabar, wherein area is clearfelled, burnt and teak seed is dibbled when plants are 6" to 35" height, the plantation was burnt and teak stems burnt, prolific shoots came out in a week, later thinned to one per stool after one month. In six months the shoots are 3 to 10 ft. high and healthy.

2595 Balagopalan, M. 1992. **Impact of fire on soil nutrient status in different forest ecosystems of Kulamav, Kerala**. National Seminar on Forest Fires, Trivandrum 29-30 September 1992.

2596 Bloch, P. 1951. **Fire damage in the deciduous forests of North Thailand**. FAO, Rome: 12p.

It has been shown that forest fire destroy or damage greater part of teak trees, aggravate erosion and retard the growth. Fire damage repeatedly affects the increment seriously and makes the forests unproductive. The effect of shifting cultivation and incendiary fires on teak forests of Siam are discussed.

2597 Branthwaite, F.J. 1905. **Fire protection in teak forests of Burma**. Indian Forester 31(7): 383-385.

2598 Burger. 1921. **Has fire protection been stopped in teak forests of Burma**. (Indonesian; English). Tectona 14: 639-642.

2599 Carter, H. 1904. **Fire protection in teak forests of Burma**. Indian Forester 30(8): 363-366.

2600 Dommers. 1909. **Forest fires as the principal cause of the rapid deterioration of our forest soils**. Tectona 2: p373.

2601 Fischer, C.E.C. 1913. **Damage to teak by fire**. Indian Forester 39(9): p434.

Illustrates the injury by fire to teak in a fire-protected forest from Punachi working circle, Annamalai Hills, South Coimbatore Division.

2602 Fischer, W.R. 1905. **Fire protection in teak forests of Burma**. Indian Forester 31(7): 385-387.

2603 Florence, L.M; Methven, I.R. 1994. **Fire behavior, fire effects and survival responses of trees**. Sylvatrop 4(2): 41-63.

Stands of different species including *Tectona grandis* with understorey grasses were subjected to three levels of fire intensity treatments. Survival responses and damage to tree seedlings and saplings by fire were influenced by fire intensity, tree species and diameter size. The success of reforestation on fire-prone grasslands can be facilitated by the use of prescribed fire and the selection of appropriate tree species.

2604 Gleadow, F. 1904. **Fire protection in the teak forests of Lower-Burma**. Indian Forester 30(5): 470-471.

2605 Hewetson, C.E. 1950. **Seventy-five years of fire protection in the tropics**. Empire Forestry Review 29(4): 339-350.

The scientific principles of application of fire protection mainly to mixed teak forest. First part describes forest types and the influence of management over 75 years on the composition. Second part gives statistics of growing stock.

2606 Jong, B.D. 1923. **Protection against forest fires in the teak district of Pakalongan-**

Kendal (Java) in 1922. (Indonesian; English). Tectona 16: 137-152.

Fires are considered incendiary are due to carelessness.

2607 Karnik, C.P. 1967. **Effect of fire on the dry deciduous forests of Satpura mountains, India**. Tropical Ecology 8(1/2), 110-116.

The various physiognamic changes are represented in Satpura mountains, and the chemical composition and nutrient status of different soils encountered has been reported.

2608 Kittinanda, S.P. 1971. **Forest fires in teak forests**. (Thai). Proceedings of the Second Forestry Conference, Royal Forest Department, Bangkok R 129: 69-79.

The general condition of forest soils, and their fertility status are discussed.

2609 Komkris, T; Naraballobh, V (et al). 1969. **Effect of fire on soil and water losses at Mae-Hnad forest, Amphur, Ngao, Lampang Province**. Forest Research Bulletin 6: 82p. Kasetsart University, Bangkok.

Study on soil and water losses on burned and unburned plots in four different forests viz. teak plantation, mixed deciduous forest with teak, deciduous dipterocarp forest and mixed deciduous forest with teak on hill side have been made.

2610 Kwe, T. 1904. **Fire protection in the teak forests of Burma**. Indian Forester 30(9): 470-471.

2611 Manson, F.B. 1904. **Fire protection in teak forests of Lower Burma**. Indian Forester 30(4): 155-156.

2612 Murray, C.H. 1961. **Teak and fire in Trinidad**. (English; Spanish). Caribbean Forester 58(3/4): 57-61.

The origin of the fires and their effects on the crop and site are discussed.

2613 Murty, L.S.V. 1954. **Control burning of teak (*Tectona grandis*) plantations**. Silva 34: p17.

2614 Oever, H.Ten. 1910. **Teak growing and forest fires**. Tectona 2: 554-616.

2615 Ogbe, G.A.E. 1956. **Growth of teak after fire in Arakanga plantation**. Nigerian Forest Information Bulletin 32: 2p. Bibliographic Agriculture United States, Department of Agriculture 1956.

2616 Oguntala, A.B. 1989 . **The climatic aspects of the 1982/83 wildfires in Nigeria**. Meteorology and agroforestry. Proceedings of an international workshop on the application of meteorology to agroforestry systems planning and management, Nairobi, 9-13 February 1987: 539-546. W.S. Reifsnyder; T.O. Darnhofer, Eds. International Council for Research in Agroforestry (ICRAF), Nairobi, Kenya.

The forest-fire climates of parts of Nigeria were studied in relation to a fire incidence which destroyed thousands of hectares of forest and farm plantations in different parts of the country during the 1982/83 dry season. After the fire, survival and regeneration of exotic trees including *Tectona grandis* were very high.

2617 Praasterink, H.C. 1911. **The significance of forest fires to our teak forests**. Tectona 4: 829-834; p609.

2618 Ribbontrop, B. 1898. **Forest fires and their effects on reproduction of teak**. Indian Forester 24: 133-135.

2619 Rietz, G. 1989. **The fire hazard of wood**. (German). Holztechnologie 30(5): 236-239; p280.

A survey of the pyrolysis, combustibility and ignitability of wood is made. Data are presented on the oxygen index of various wood species, wood-based products and wood dusts. Teak is ranked first in fire resistance.

2620 Rodger, H. 1907. **The effects of fire in teak forests**. Indian Forester 33(1): 17-18.

2621 Slade, H. 1896. **Too much fire protection in Burma**. Indian Forester 22(5): 172-176.

The desirability of too much fire protection in all classes of teak forests of Burma is discussed and the problems of management are also stressed.

2622 Timmer, P. 1911. **Protection against forest fires in the North Kradenan Forest Division**. Tectona 4: 702-722.

2623 Troup, R.S. 1905. **Fire protection in the teak forests of Burma-I**. Indian Forester 31(3): 138-146.

Reports the results of enumeration of teak seedlings and young poles from two adjoining pieces of forests - one is protected

from fire for many years and other annually burnt.

2624 Troup, R.S. 1905. **Fire protection in the teak forests of Burma-II**. Indian Forester 31(9): 503-505.

2625 Walker, H.C. 1903. **Fire protection in the teak of Lower Burma**. Indian Forester 29: 554-562.

Go top

Damage by Plants, Weeds and Control

(See also 2044)

2626 Alam, M.K. 1984. **A critical review on the biology and control of Loranthaceae with a particular reference to Bangladesh**. Bano Biggyan Patrika 13(1/2): 7-18.

A discussion of the fifteen mistletoe and other parasitic species occurring in Bangladesh which cause serious damage in many important species including *Tectona grandis*.

2627 Ali, M.I.M; Florence, E.J.M. 1987. **A leaf blight of teak mistletoe, *Dendrophthoe falcata*, in Kerala, India**. Transactions of the British Mycological Society 88(2): 275-277.

Leaf blight of *D. falcata* var. *pubescens* caused by the Colletotrichum state of *Glomerella cingulata* is reported. The possibility of using this isolate for the biological control of *D. falcata* is discussed.

2628 Altona, T. 1929. **Damage to teak plantations by *Loranthus* spp**. (Indonesian; English). Tectona 22: 323-352.

Loranthus damage results in decrease of assimilation, consequent smaller development of leaves, diminution of resistance of pests, mutilation of branches or tops, decrease of wood quality and lastly death of teak tree.

2629 Amakiri, M.A. 1983. **Weeds and weed control in a forest plantation in the rainforest zone of Nigeria**. Proceedings of the Second Biannual Conference, West African Weed Science Society: 272-281. West African Weed Science Society, Abidjan, Ivory Coast.

Soil samples from a *Tectona grandis* plantation in which 18 weed spp. were identified.

2630 Anoop, E.V; Kumar, B.M; Abraham, C.T. 1994. **Teak (*Tectona grandis*) growth in response to weed control treatments**. Journal of Tropical Forest Science 6(4): 379-386.

A field experiment was conducted to test the efficacy of seven weed control treatments in young teak plantations in Kerala. Growth measurements were recorded after the first weed control treatment and manual weeding produced rapid height growth.

2631 Balasundaran, M. 1996. **Impact of mistletoe infestation on growth and survival of teak**. Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium, Peechi, 23-26 November 1993: 28-32. K.S.S. Nair; J.K. Sharma; R.V. Varma, Eds. Kerala Forest Research Institute, Peechi.

The parasite retards the growth of trees and also affects the physical properties of wood and severely infested trees dry up gradually.

2632 Balasundaran, M; Ali, M.I.M. 1989. **Control of teak mistletoe through trunk injection of chemicals**. KFRI Research Report 59: 10p. Kerala Forest Research Institute, Peechi.

The study of the possible control of teak mistletoe in Kerala has suggested infusion of suitable weedicides into the trunk as a possible method for selective killing of mistletoe without harming teak trees. Metribuzin infused into parasite-infected trees.

2633 Balasundaran, M; Ali, M.I.M. 1997. **Mistletoe problem of teak and its control measures**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 118-121. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department and Kerala Forest Research Institute, Peechi.

A preliminary study on the phenology and distribution of the parasite in Kerala and severity of infection in Nilambur Forest Division had been carried out. It is found that the percentage of infestation was 47 to 86 percent and the increment loss due to the parasite infestation was 37 to 42 percent over non-infested trees.

2634 Beeson, C.F.C; Chatterjee, P.N. 1940. **Possibilities of control of Lantana by indigenous**

insect pests. Indian Forest Records (n.s) Entomology 6(3): 58p.

2635 Biswas, S; Chandra, S. 1992. **An observation on teak (*Tectona grandis* Linn.f.) as a phorophyte**. Indian Forester 118(11): p871.

During a study of the epiphytic flora of New Forest, Dehra Dun, Indian teak was found acting as a phorophyte for several angiosperm species. These included Loranthaceous species such as *Dendrophthoe falcata* and other epiphytes.

2636 Clarson, D; Sudha, P. 1997. **Studies on the weeds infestation and their management in teak plantations**. Indian Forester 123(8): 740-745.

A study undertaken in the teak plantations of Sterling Tree Magnum, at various locations in Tamil Nadu, showed that grasses such as *Cynodon* and *Cyperus* spp. were the dominant weed species found.

2637 Coster, C. 1932. **Some observations on the growth of alang-alang (*Imperata cylindrica* Beauv.) in teak forests and its extermination**. Tectona 25(4): 383-402.

Grass is considered harmful to teak plantations as a root competitor. It is highly fire resistant and with quick growth rate it is harmful to teak as a small piece of rhizome can rejuvenate and infest the whole plantation.

2638 Daryono, H; Hamzah, Z. 1979. **A study of *Eupatorium odoratum* as a weed in teak (*Tectona grandis*) forest**. (Indonesian). Laporan, Lembaga Penelitian Hasil Hutan 312: 25p.

Biomass, nutrient content, transpiration and effects of *Eupatorium odoratum* on the growth of teak were studied.

2639 Etuk, E.I. 1973. **A preliminary survey of the weeds in teak plantations in the Western State of Nigeria**. Obeche 8-9: 37-48.

A preliminary survey of weeds in *Tectona grandis* plantations in two vegetation zones in Nigeria, viz. tropical rain forest and derived savanna is made. Twenty five weed species are listed from the plantations in tropical rain forest and six from those in savanna.

2640 Forest Department, Madras. 1942. **On control of *Loranthus* in teak plantations**. Annual Report on Silvicultural Research in the Madras Presidency for the year 1940-41: p84.

Control of *Loranthus* in teak plantations was brought about by cutting the affected branches and laying the cut branches in an open space where they dried up without producing flowers or fruit.

2641 Forest Department, Trinidad and Tobago. 1954. **Mistletoe on teak in Trinidad**. Report of Forest Department, Trinidad and Tobago 1952: 10p.

Many species of Loranthaceae occur but only two are serious parasites of teak. The parasite is cut out from young teak plantations during the leafless period and at the same time all infested trees are cut in a 1/4 mile strip all round the teak in the surrounding forest. The attack appears to be more severe on poor soils.

2642 Forest Research Institute, Dehra Dun. 1949. **Effect of Lantana on teak**. Forest Research in India and Burma 1948-49 Part II: p36.

Wyanad experiments indicated a significant lower volume increment with dense growth of Lantana.

2643 George, K. 1966. **Selective control of *Loranthus* on teak**. (Afrikaans; Persian; Bulgarian). Current Science 35(17): p444.

Tests showed the efficacy of 1:1-dimethyl 4:4-bipyridylium spray applied in early summer when the teak is leafless.

2644 Ghosh, S.K; Balasundaran, M. 1980. **A simple technique for injecting chemicals into teak**. Current Science 49(21): 827-828.

The technique, demonstrated using rhodamine B dye, has been developed to control the parasitic angiosperm *Dendrophthoe falcata* var. *pubescens* in India.

2645 Ghosh, S.K; Balasundaran, M; Ali, M.I.M. 1982. **Chemical control of *Dendrophthoe falcata* on teak through trunk injection: A preliminary field study**. Current Science 51(23): p1119.

Aqueous solutions of various herbicides were infused into trees in a plantation using a cheap injection technique developed earlier.

2646 Ghosh, S.K; Balasundaran, M; Ali, M.I.M. 1983. **Possible teak mistletoe control through trunk-injection of weedicide**. Proceedings of the 10th International Congress of Plant Protection 1067. British Crop Protection Council, Croydon, UK.

In trials in teak plantations using locally manufactured injection equipment, metribuzin provided control of mistletoe. Gramoxone (paraquat), Afalon (linuron), Tolkan (dinoterb + isoproturon) and dalapon were also found active against mistletoe.

2647 Ghosh, S.K; Balasundaran, M; Ali, M.I.M. 1984. **Studies on the host-parasite relationship of phanerogamic parasites(s) on teak and their possible control**. KFRI Research Report 21: 39p. Kerala Forest Research Institute, Peechi.

Studies are reported on the biology of the teak mistletoe, its distribution in Kerala, host species, the phenology of host and parasite, biotic factors and natural enemies, assessment of losses, and management.

2648 Ghosh, S.K; Balasundaran, M; Ali, M.I.M. 1988. **Towards the control of mistletoe on teak through tree injection using weedicides**. Trends in Tree Sciences: 185-192. P.K. Khosla; R.N. Sehgal, Eds. Indian Society of Tree Scientists, Solan.

Dendrophthoe falcata var. *pubescens* Hooks. f. is one of the most destructive parasites on teak plantations in Kerala. The study deals with the development of a technique of trunk injection of teak and screening of weedicides for selective killing of parasite without harm to the host. The technique of tree injection has been perfected using cheap locally fabricated metallic nozzles, distributors, plastic reservoir and dripper set.

2649 Gnanaharan, R; Balasundaran, M. 1997. **Effect of mistletoe attack on teak wood**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 122-123. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

The teak plantations in Kerala are affected by a mistletoe, *Dendrophthoe falcata* var. *pubescens*. The study conducted to assess the effect of mistletoe on teak revealed that wood of mistletoe infested trees had ultimate strength values nearly 14 percent lower than that of non-infested trees. The mistletoe infestation reduced the modulus of elasticity of wood.

2650 Gnanaharan, R; Ghosh, S.K; Balasundaran, M. 1983. **Effect of mistletoe on the strength properties of *Tectona grandis* Linn.f.** Materials und Organismen 18(4): 313-318.

Teak attacked by mistletoe was tested for strength properties. The modulus of rupture and work to maximum load are affected by the parasite attack.

2651 Harley, K.L.S; Kunimoto, R.K. 1969. **Assessment of the suitability of *Plagiohammus spinipennis* (Thoms.) (Col, Cerambycidae) as an agent for control of weeds of the genus *Lantana* (Verbenaceae). I. Life-history and capacity to damage *L. camara* in Hawaii. II. Host specificity**. Bulletin of Entomological Research 58(3/4): 567-574.

Reports field studies in two range areas where the insect has been introduced and found effective biological control of *L. camara*.

2652 Hawksworth, F.G. 1974. **Mistletoes on introduced trees of the world**. United States Department of Agriculture 469: 49p.

All the mistletoes are listed with their hosts and the area of its origin.

2653 Kadambi, K; Dabral, S.N. 1954. **Tests on the efficacy of Fernoxone in killing of various forest trees**. Indian Forester 80(10): 653-658.

On teak trees with diameter range 6.3 to 9.3 inches when given a dose of .5 oz. of Fernoxone, it was ineffective and all these trees sprouted after sometimes.

2654 Kalita, R.K; Chandra, A. 2002. **Natural infestation of mistletoe in various trees in Jorhat District of Assam**. Indian Forester 128(7): 815-816.

A preliminary survey was conducted along village roads in Assam, India to assess the status of mistletoe infestation in areas of Jorhat District. This parasite was observed in eleven tree species which include *Tectona grandis*.

2655 Kallarackal, J; Soman, C.K. 2002. **Ecophysiology of a host parasite relationship in teak**. KFRI Research Report 228. Kerala Forest Research Institute, Peechi.

This document reports the ecophysiological aspects of a host parasite relationship in teak infested with *Dendrophthoe falcata*.

2656 Kallarackal, J; Soman, C.K; Rajesh, N. 2003. **Teak and its canopy parasite *Dendrophthoe* - water relations and ecophysiology**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Teak is widely infested with *Dendrophthoe falcata*. The mistletoe clumps cause enormous reduction in the yield of timber, sometimes leading to the death of the whole tree. This paper explains the ecophysiological factors that help the survival of this parasite.

2657 Koppikar, H.T. 1948. **Control of *Loranthus* pest in forest plantations**. Indian Forester 74(5): p207.

Loranthus is becoming a serious pest of teak plantations. The measures recommended for its control are removal of affected branches and maintenance of an insulating belt of minor forest between the plantations and cultivated ground, gardens, etc.

2658 Kumar, A; Kadam, R.S. 1993. **Control of bamboo in teak plantations and some observations on bamboo flowering**. BIC India Bulletin 3(1): 24-26.

In young teak plantations, bamboo regeneration is found causing stunted growth of teak. Maharashtra Van Sanshodhan Sanstha conducted an experiment to control bamboo growth in such plantations using various treatments which are mentioned in the paper.

2659 Misra, R.M. 1985. **A note on *Leptobyrsa decora* (Hemiptera:Tingitidae) a bio-control agent of *Lantana camara* (Verbenaceae)**. Indian Forester 111(8): 641-644.

During host-specificity tests at Dehra Dun, the insect was found able to complete its full life-history on teak. In view of the likely danger to teak, the whole culture of the insect was destroyed.

2660 Moni, N.S; George, M.P. 1959. ***Eupatorium odoratum* - a common weed found in the teak plantations of Kerala State**. Indian Forester 85(12): 728-730.

All methods of controlling this weed have so far proved to be uneconomic. It is proposed to establish a pilot plant to produce fertilizers from *E. odoratum* for field tests.

2661 Muraleedharan, P.K; Anitha, V. 2000. **The economic impact of *Mikania micrantha* on teak plantations in Kerala**. Indian Journal of Forestry 23(3): 248-251.

A pilot survey conducted to examine the economic impact of *Mikania micrantha* infestation on teak plantations in Kerala showed that *M. micrantha* has increased the cost of planting and has adversely affected the profitability of the plantations and there was a significant difference in the cost of maintenance of teak plantations with and without *M. micrantha*.

2662 Murray, C.H. 1967. **Arboricides and clonal teak**. Commonwealth Forestry Review 46(2): 133-137.

A mixture of 2,4-D and 2,4,5-T applied to control weeds in a teak clone orchard which caused severe injury to the teak.

2663 Nair, P.N. 1973. **The effect of Gramoxone application on *Eupatorium odoratum***. Indian Forester 99(1): 43-48.

Gramoxone treatments were found ineffective and it is concluded that manual weeding is more effective and economical method of control.

2664 Qureshi, I.M. 1956. **Use of chemicals for killing or eradication of weeds**. Proceedings of the 9th Silvicultural Conference, Dehra Dun, 1956, Part 2: 70-71. Forest Research Institute, Dehra Dun.

A brief description of the preliminary experiments in Bombay state in the control of *Loranthus* on teak by injecting the host with $CuSO_4$ and Fernoxone.

2665 Rahman, M.M; Baksha, M.W; Sterringa, J.T. 1993. **Ethological observations of the purple sunbird (*Nectarinia asiatica* Latham): A mistletoe-frequenting bird**. Indian Forester 119(5): 388-394.

The bird eats the fruit of mistletoes parasitic on *Gmelina arborea* and teak and disperses mistletoe seeds in forest plantations. Nectar of *Thevetia peruviana* appears to be a preferred food and it is suggested that planting *T. peruviana* in gamar and teak plantations would minimize dispersal of mistletoe seeds.

2666 Soesilotomo, P.S; Purwadi. 1991. **Methods of abolishing parasitic plants on teak trees in Parengan Forest District**. (Indonesian). Duta Rimba 18(145/146): 7-11.

Methods used for the control of mistletoes on teak in this district of Java are described.

2667 Suharti, M. 1976. **The intensity of *Loranthus* spp. attack on teak stands in Central Java in relation to the age and site classes**. (Indonesian). Laporan, Lembaga Penelitian Hutan 238: 17p.

2668 Suharti, M; Prawira, S.A. 1975. **Mistletoe attack on teak stands in Java**. Laporan, Lembaga Penelitian Hutan 206: 22p.

Descriptions are given of three species of *Loranthus* and *Viscum articulatum* attacking teak in Java. The biology and control of mistletoe are reviewed.

2669 Suharti, M; Sudjud, D.A. 1978. **Experiment on *Mikania micrantha* control with herbicides**. (Indonesian). Laporan, Lembaga Penelitian Hutan 281: 30p.

The climbers *M. cordata* and *M. micrantha* compete with teak for nutrients, space and light and cause mechanical damage to the trees. 2,4-D-amine and glyphosate showed promise in greenhouse.

2670 Tjitrosoedirdjo, S; Umaly, R.C. 1991. **The status of *Chromolaena odorata* (L.) R.M. King and H. Robinson in Indonesia**. Biotrop Special Publication 44: 57-66.

C. odorata is a problem in teak plantations and in pasture and it has become an important weed of perennial crops. Brief notes are given on its control, management and areas of future research.

2671 University of West Indies, Trinidad . 1965. ***Phthirusa adunea* - on *Tectona grandis***. Annual Report, Herbicide Research Unit, 1964: 9p. Regional Research Centre, University of West Indies, Trinidad.

Control of *Phthirusa adunca* parasite on teak, promising results were given by 1 and 5 percent of paraquat and 0.2 percent of 2,4,-D applied by spray.

2672 University of West Indies, Trinidad . 1967. **On control of *Phthirusa aduncea* - a parasite of teak trees**. Annual Report, Herbicide Research Unit 1966: 16p. University of West Indies, Trinidad .

Phthirusa adunca, a parasite of teak trees, was killed by a paraquat at 5 percent concentration.

Go top

Damage by Animals

(See also 1483)

2673 Best, J.W. 1909. **On teak browsing**. Indian Forester 35: p613.

Alludes that stunted and shrubby growth of teak is due to heavy grazing in Bhandra District. But Troup attributes it to hardening of the soil. Heavy grazing is harmful in coppice areas, where coppice shoots are soft and easily broken or trampled down by cattle.

2674 Chacko, K.C; John, C.H. 1999. **Spotted deer menace in young teak plantations**. Evergreen 42: p7.

Dealt with the deer damage in an experimental plantation at the Veluppadam Field Research Centre at Kerala Forest Research Institute.

2675 Deventer, A.J van. 1916. **Measures against wild-grazing in reserved forests**. (Dutch; English). Tectona 9: 83-89.

2676 Forest Department, Sudan. 1950. **Teak in Upper Nile province**. Report of Forest Division, Sudan 1949: 22P. Forest Department, Sudan.

Teak planted north of the Yirrol Road in a light soil was well established in spite of possible elephant damage. At Malwal Chat some trees had been killed by rats and mice tunnelling and gnawing their roots. At Terakikka some teak had been killed by stagnant water collecting in depressions in the clay.

2677 Jayson, E.A. 1986. **Elephant damage in teak plantations**. Evergreen 17: 14-15.

Discussed the damages made by elephants in teak plantations which are classified into four categories such as breaking of branches, breaking of main stem, complete damage and uprooting of trees. Control measures are also suggested.

2678 Jenkins, R.K.B; Corti, G.R; Fanning, E; Roettcher, K. 2002. **Management implications of antelope habitat use in the Kilombero Valley, Tanzania**. Oryx 36(2): 161-169.

High cattle densities, expanding human settlements and the conversion of miombo woodland into farms and teak plantations are found threatening wildlife populations in the Kilombero Valley, Tanzania. The effect of land use change on antelops was investigated in the area of mixed land use.

2679 Jenkins, R.K.B; Roettcher, K; Corti, G. 2003. **The influence of stand age on wildlife habitat use in exotic teak tree (*Tectona grandis*) plantations**. Biodiversity and Conservation 12(5): 975-990.

In the Kilombero Valley, Tanzania miombo wood land is converted into teak plantations and small and private farms. The impact of this habitat change on wildlife populations is poorly assessed. Here assessed the frequency of habitat use of large mammals in teak plantations of different age during the wet season. Areas converted into teak plantations provide suitable habitat for wildlife in the Valley.

2680 Kamalpur, V.R. 1934. **Forking of teak plants**. Indian Forester 60(1): p79.

The author attributes forking to grazing and damage by cattle.

2681 Knoop, W.J. 1915. **Notes on cattle grazing in government forests-with special reference to teak forests of East Toeban forest district**. Tectona 8: 620-640.

2682 Madhavan Pillai, N. 1997. **Elephants and teak plantations**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 251-252. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

A study of the habitat preference by the elephants indicate that the elephants prefer teak plantations rather than evergreen forests with thick undergrowth. Although damage to the teak plantations by the elephants has been reported, it is negligible compared to the vast extent of teak plantations existing in the state.

2683 Meindersma, H.W. 1926. **Cattle grazing in Government teak forests**. (Dutch). Tectona 19: 1070-1071.

2684 Nair, P.V; Jayson, E.A. 1990. **Interaction between elephants and teak plantations in Parambikulam Wildlife Sanctuary**. Proceedings of the Symposium on Ecology, Behaviour and Management of Elephants in Kerala, Trivandrum, 23-24 February 1990: 58-65. Kerala Forest Department, Trivandrum.

This study was conducted at the Parambikulam Wildlife Sanctuary to compare teak plantations of different age with adjoining natural forests in terms of food availability, abundance of animals and damage by wild animals. Animals like gaur, elephant, deer, wild pig and rodents were found in all plantations. Elephants were maximum in three year old plantation. Main damage to the plantations were from elephants.

2685 Pais, A. 1926. **Combating hare and rat attacks in teak plantations**. Indian Forester 52(9): 489-491.

Recommended measures are listed.

2686 Sihler, K. 1924. **Cattle grazing in Government forests**. (Dutch; German; English). Tectona 17: 201-219.

The rights and legal status of natives determine the regulation of grazing in state forests and the author suggests regulation or prohibition gradually of all grazing rights.

Go top

Fungi and Bacteria

(See also 1559, 4480, 4490-4494, 4497-4510, 4518, 4524, 4525, 4528, 4531)

2687 **List of common names of Indian plant diseases**. Indian Journal of Agricultural Sciences 20 (Part-I), 1950: p139.

Lists the following diseases of *Tectona grandis*, brown rust, white spongy-rot, white spongy rot, white sap and heart-rot, white spongy rot, canker and mildew.

2688 Abraham, K.J; Daniel, M; Rai, S.N. 1988. **Phytoalexins and related post-infectional compounds of forest crops of Gujarat**. Advances in Forestry Research in India 1: 191-197.

Analyses were made of pre and post infectional compounds in the leaves of species including teak infected with different pathogenic or non-pathogenic fungi in Gujarat. Flavonoids, phenolic acids and xanthones were all produced following infection. It is suggested that these changes are mechanisms for combating infection. The potential use of these compounds, which are considered to be phytoalexins, is discussed.

2689 Ali, M.I.M; Florence, E.J.M. 1994. **Studies on collar rot of teak seedlings**. Indian Forester 120(1): 69-72.

Symptoms and disease development are briefly described. Describes the results of pathogenicity tests with isolates of the pathogen identified as responsible and of fungicidal evaluation tests in the laboratory.

2690 Altona, T. 1923. **Heart rot in *Tectona grandis* Linn.f.** (Indonesian; English). Tectona 16: 456-473.

The heart rot caused stains in the heartwood, healthy and diseased wood are separated by a dark band. The disease caused probably by a fungus, manifests externally by many adventitious buds, dead tops, and horizontal and vertical clefts appearing in the bark.

2691 Altona, T. 1926. **Damage of teak by *Corticium javanicum* syn. *C. salmonicolor*-Djamoer *oepas***. (Indonesian; English). Tectona 19: 31-53.

Attack leads to the death of branches, shoots or stems in less favorable conditions. Large holes are caused in the bark and the holes penetrate deeply into wood and thus staining and damaging wood by entry of water. Control measures suggested include wide planting distance, early thinning, removal of infested trees etc.

2692 Bagchee, K.D. 1947. **An unrecorded parasite of teak (*Tectona grandis* Linn.f.) reported from Dehra Dun**. Indian Forester 73(7): 332-334.

A disease of young teak trees, characterized by the leaves turning yellow and falling very prematurely and by lesions under the bark, followed by the appearance of pink to red perithecia in the cracks and cavities of the bark.

2693 Bagchee, K.D. 1952. **A review of work on Indian tree diseases and decay of timber and methods of control**. Indian Forester 78(2): 540-546.

A review of the diseases of Indian forest trees including teak and the decay of timber and discusses methods of control.

2694 Bagchee, K.D; Singh, U. 1954. **List of common names of fungi attacking Indian forest trees, timber and the herbaceous and shrubby undergrowths and list of cultures of forest fungi**. Indian Forest Records (n.s) Mycology 1(10): 311-312.

Tectona grandis is one of the 656 species dealt with in the publication.

2695 Bakshi, B.K. 1966. **Root rot of teak**. Nature 210(5038): p784.

Two pathogens, *Polyporus zonalis* and *Peniophora* sp are isolated from teak. *Peniophora* is reported first time on teak. This species colonizes old coppiced stumps and spreads freely through the soil by rhizomorphs which infect healthy roots.

2696 Bakshi, B.K; Singh, S; Singh, U. 1966. **A new root rot disease complex in teak**. Indian Forester 92(9): 566-569.

The pathogens are identified as Polyporus zonalis and Peniophora rhizomorphosulphurea sp.

2697 Balasundaran, M; Sankaran, K.V. 1991. ***Fusarium solani* associated with stem canker and die-back of teak in southern India**. Indian Forester 117(2): 147-149.

The primary symptom was canker development followed by leaf yellowing and shedding and dieback and the causative organism was identified as *Fusarium solani*.

2698 Balasundaran, M; Sharma, J.K; Florence, E.J.M; Mohanan, C. 1995. **Leaf spot diseases of teak and their impact on seedling production in nurseries**. Caring for the Forest Research in a changing world: Proceedings of the 20th World Congress, Tampere, Finland, 6-12 August 1995: p170.

Leaf spot caused by *Phomopsis* sp., *Colletotrichum gloeosporioides, Alternaria* sp. and *Curvularia* sp., leaf rust by *Olivea tectonae* and powdery mildew by *Uncinula tectonae* are the major leaf diseases in nurseries in Kerala.

2699 Banerji, S.N; Bakshi, B.K. 1945. **Studies on the biology of wood-rotting fungi of Bengal**. Journal of Indian Botanical Society 24: 73-92.

This paper gives the geographical distribution, occurrence, effect of light, temperature, humidity and substratum etc. on the growth and cultural character of six fungi including *Polystictus steinhellanus*.

2700 Basak, A.C. 1992. **Bacterial wilt disease of teak seedlings in the forest nurseries and its control**. Bangladesh Journal of Forest Science 21(1/2): 67-68.

The bacterial wilt is caused by *Pseudomonas solanacearum* in Bangladesh.

2701 Batra, L.R. 1964. **Two new ambrosia fungi - *Ascoidea asiatica* and *A. africana***. Mycologia 56(4): 632-636.

A. asiatica sp. nov. was isolated from *Xyleborus velatus* infesting *Tectona grandis* imported from Burma, and *A. africana* sp. nov. from lymexylonid larvae infesting *Chlorophora excelsa* imported from W. Africa.

2702 Bernasco, W. 1908. **Fungal diseases in teak plantations**. (Indonesian; English). Tectona 1(4): 342-343.

2703 Broeker, F.W. 1991. **Discoloration of teakwood due to rust?** Holz Zentralblatt 117(116): p1804.

2704 Chalermpongse, A. 1990. **Introduction to forest pathology in Thailand**. Proceedings of IUFRO Workshop on Pests and Diseases of Forest Plantations, Bangkok, 5-11 June, 1988: 107-113. C. Hutacharern; K.G. MacDicken; M.H. Ivory; K.S.S. Nair, Eds.

The paper summarises information about potentially dangerous forest tree diseases reported in Thailand. Some control measures are also recommended.

2705 Champahaka, U. 1966. **New disease of teak seedlings. A report to the Fifth National Conference of Agriculture and Biology, Bangkok**. Royal Forest Department, Bangkok.

2706 Champahaka, U. 1966. **Report on wilting of teak**. (Thai). Proceedings of the Fifth National Conference of Agricultural Series in plants, Bangkok, Thailand: 6p. Kasetsart University, Bangkok.

Wilting of teak seedlings observed in Tak teak seed orchard is attributed to wilting. The disease is attributed to various fungi.

2707 Chatterji, A.L. 1912. **A new species of mildew**. Indian Forester 38(1): 28-30.

A new fungus identified as *Uncinula tectonae* attacks upper surface of teak leaves giving a bluish appearance to the trees. It probably interferes with the assimilative power of chlorophyll by cutting off light partially.

2708 Chowdhury, K; Khan, S.N. 1990. **Occurrence of soft rot in preservative treated timbers in field tests and outdoor use**. Indian Journal of Forestry 13(4): 345-348.

Studies were made in India on the occurrence of soft rot in preservative treated timbers including teak from graveyard tests. Teak was the most rot-resistant species. A total of 150 isolates belonging to 34 fungi was obtained from the samples.

2709 Coster, C. 1924. **Physiological and pathological kernel formation in teak (*Tectona grandis* Linn.f.)**. (Indonesian; German). Tectona 17: 620-628.

2710 CSIRO. 1984. **Proceedings of the Sixth International Conference on root and butt rots of forest trees, Melbourne, Victoria and Gympie, Queensland, Australia, 25-31 August 1983**. CSIRO and IUFRO Working Party 01, Melbourne, Australia.

The proceedings consists of a number of papers related to the topic in which the following papers are related to teak. 1. Inbreeding, hybridization and conservation in provenances of tropical forest trees. 2. Evaluation of a series of teak and gmelina provenance trials - selection of traits, their assessment and analysis of observations, provenance X environment interaction. 3. Its detection, practical importance and use with particular reference to tropical forestry. 4. Strategies for the incorporation of new provenance material in existing breeding populations of tropical forest trees. 5. Influence of propagation by cuttings on the breeding strategy of forest trees.

2711 Dadwal, V.S; Jamaluddin. 1988. **Role of fungi in weathering of teak fruits**. Indian Forester 114(6): 328-330.

Teak fruits are weathered before use in the nursery in order to promote early germination. Several microorganisms including fungi play an important role in the degradation of the epicarp; microbial activity also loosens the hard mesocarp. Data are tabulated on the percentage of occurrence of 13 fungal species on fresh fruits collected in Mandla Division, Madhya Pradesh.

2712 Dadwal, V.S; Jamaluddin. 1989. **Diseases of teak (*Tectona grandis*) in nursery and plantation and their control**. Seminar on Forest Protection, Dehra Dun, 29-30 June 1989. Forest Research Institute, Dehra Dun.

2713 Dadwal, V.S; Jamaluddin. 2001. **A note on basal canker of teak (*Tectona grandis*) in plantations**. Indian Forester 127(3): 365-366.

This paper describes the symptoms, pathogenicity and control of the basal canker which was caused by a soil-borne pathogen, *Fusarium pallidoroseum* of teak.

2714 Damle, K. 1960 . ***Uncinula tectonae* Salmon on *Tectona grandis* Linn.f.** Journal of Indian Botanical Society 39(2): 243-258.

A study of the morphology, development and cytology of the fungus.

2715 Doo, S.C. 1968. **Bacterial wilt of teak seedlings**. Union Burma Journal of Life Science 1(1): 43-45.

Describes the symptoms of the wilt, which is caused by interruptions of sap flow in the xylem vessels owing to the multiplication and accumulation of bacterial masses. The causal organism was identified as Pseudomonas sp.

2716 Forest Department, Vellore. 1917. **On mixtures and attack of *Hapalia machaeralis* in North Vellore Division**. Inspection Note of Conservator of Forests, Vellore 1921: p729. Forest Department, Vellore.

Reports on the attack of teak trees planted in the midst of mixed forest by *Hapalia machaeralis*.

2717 Gibson, I.A.S. 1975. **Diseases of forest trees widely planted as exotics in the tropics and southern hemisphere. Part 1. Important members of the Myrtaceae, Leguminosae, Verbenaceae and Meliaceae**. 51p. Commonwealth Forestry Institute, Kew, UK; Commonwealth Mycological Institute, Oxford, UK.

Information on tree diseases and damage caused by fungi, bacteria, viruses, algae, parasitic higher plants and nematodes is given, with notes on mycorrhiza and beneficial bacterial associations. Stem, leaf and root diseases, rots and stains and mycorrhiza are discussed separately for important trees including *Tectona grandis*.

2718 Gibson, I.A.S; Corbett, D.C.M. 1964 . **Variation in isolates from *Armillaria* root disease in Nyasaland**. Phytopathology 54(1): 122-123.

Describes certain characters of the fungus infecting plantations including *Tectona grandis*.

2719 Gowda, H.C.H; Naik, S.T. 2002. **Morphological variation in *Ganoderma lucidum* affecting different tree species**. Myforest 38(2): 151-153.

A study was conducted to find out the morphological variation in *Ganoderma lucidum* affecting tree species including teak.

2720 Griffoen, K. 1949. **Some wood-destroying fungi of Indonesia**. (Dutch; English). Tectona 39: 348-367.

The activity of some wood destroying fungi was investigated by means of laboratory test method under controlled conditions on several species of timber specimens including teak. *Polystictus hirsutus* is proved to be the most dangerous.

2721 Hansbrough, J.R (Ed). 1964. **Diseases of widely planted forest trees**. FAO/IUFRO Symposium on Internationally Dangerous Forest Diseases and Insects, Oxford, 1964, FAO/FORPEST 64: 237p.

Includes eighteen papers summarizing information on the major pathogens of forest trees including *Tectona grandis*.

2722 Harsh, N.S.K; Rai, B.K; Rai, A. 1994. **Fungi associated with pollen grains and seeds of *Tectona grandis***. Journal of Tropical Forestry 10: 319-321.

2723 Harsh, N.S.K; Tiwari, C.K; Nath, V. 1989. **Foliage diseases in forest nurseries and their control**. Journal of Tropical Forestry 5(1): 66-69.

Symptoms and control methods are briefly reported for foliage diseases caused by fourteen fungal pathogens in the nurseries of Madhya Pradesh. The diseases include leaf spot disease caused by *Phyllosticta tectonae* on *Tectona grandis*.

2724 Harsh, N.S.K; Tiwari, C.K. 1995. **Assessment of damage caused by heart rot in teak in Madhya Pradesh**. Indian Forester 121(6): 540-544 [Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium, Peechi, 23-26 November 1993: 61-65. K.S.S. Nair, J.K. Sharma; R.V. Varma, Eds. Kerala Forest Research Institute, Peechi, 1996].

An appraisal was made of heart rot damage in natural teak forests in Madhya Pradesh. Results showed that 38 to 88 percent of trees were affected by heart rot.

2725 Hart, H.M.J. 1925. **On a root fungus in teak plantations**. (Indonesian; English). Tectona 18: 749-754.

Dying of young teak trees in Java is reported due to a root fungus. Eradication suggested by allowing agriculture and deep cultivation of soil for 2-3 years.

2726 Hocking, D. 1966. **Root rot of teak. 2. Further field observations, with new records of *Armillaria mellea***. East African Agricultural Forest Research Organization, Mycological Note 44: 4p.

The survey of the root rot of teak plantations in Tanzania and Kenya confirmed that damaging root diseases were present in all areas examined, and that most diseased trees were associated with *Helicobasidium compactum*.

2727 Hocking, D. 1968. **Stem canker and pink stain of teak in Tanzania associated with *Fusarium solani***. Plant Disease Reporter 52(8): 628-629.

F. solani was consistently isolated from collar and stem cankers and from pink-stained wood of mature *Tectona grandis*. Isolates killed seedlings when inoculated in wounds in the bark, the wood under the lesions was pink, and *F. solani* was recovered from the seedlings.

2728 Hocking, D; Jaffer, A.A. 1966. **Field observations on root rot of teak and nursery disorders**. Tropical Pesticides Research Institute, Arusha, Miscellaneous Report 567: 12p.

A survey of diseases of teak in E. Africa showed that nurseries were generally healthy, but on poorly drained sites, showed symptoms of violet root-rot associated with *Helicobasidium compactum*.

2729 Hocking, D; Jaffer, A.A. 1966. **Field observations on root rot of teak and nursery disorders**. East African Agricultural Forest Research Organization, Mycological Note 41: 6p.

Preliminary study suggests that the violet root rot, caused by *Helicobasidium compactum* cause the loss of 100,000 seedlings in a nursery in a poorly drained site in Tanzania. The nursery was moved to a better-drained site and no recurrence has been observed.

2730 Hocking, D; Jaffer, A.A. 1967. **Field observations on root rot of teak in Tanzania**. FAO Plant Protection Bulletin 15(1): 10-14.

Patches of root rot were found in newly established plantations and the disease was spreading at a rate of 12-18 ft. per annum. The probable cause of root rot is *Helicobasidium compactum*, favoured by poor drainage.

2731 Hosagoudar, V.B. 2004. **New species, new records and a rare fungus**. Zoos' Print 19(3): 1386-1389.

Deals with an account of five leaf infecting microfungi collected from Kerala, India which include *Sarcinella tectonae* found on *Tectona grandis*.

2732 Imperial Forestry Institute. 1926. **A teak disease (*Corticum javanicum*)**. Imperial Forestry Institute Bulletin 24: p277.

2733 Kalshoven, L.G.E. 1936. **Attack on teak by *Monohammus rusticator***. Tectona 29(11/12): 875-881.

2734 Karadge, B.A; Chavan, P.D; Thite, A.N. 1980. **Changes in phenolic compounds of teak leaves induced by powdery mildew infection**. Indian Phytopathology 33(1): 114-116.

2735 Kawabe, Y; Kamizore, S; Aihara, H. 2002. **Seedling diseases in large-scale nurseries of the reforestation and extension project in North East Thailand**. Proceedings of the IUFRO FAO workshop on Pest management in tropical forest plantations, Chanthaburi, Thailand 25-29 May 1998. C. Hutacharern; B. Napompeth; G. Allard; F.R. Wylie, Eds. FORSPA Publication 30: 53-58. FAO Regional Office for Asia and the Pacific, Bangkok, Thailand.

Surveys of seedling diseases were carried out in four large-scale nurseries in the Northeast of Thailand and the disease include rust of *Tectona grandis*.

2736 Khan, A.H. 1951. **Some diseases observed in the teak plantations of East Bengal**. Pakistan Journal of Forestry 1(3): 209-212.

Notes on rust caused by *Uredo tectonae*, and a root rot caused by an unidentified *Polyporus* sp.

2737 Khan, A.H. 1952. **Wood rotting fungi of Pakistan and their control**. Pakistan Journal of Science 4(2): 65-69.

Lists *Irpex flavus* kl. as a fungus attacking *Tectona grandis*.

2738 Khan, M.A.W. 1964. **Root rot and patch mortality disease in equatorial teak of the Sudan**. FAO/IUFRO Symposium on Internationally Dangerous Forest Diseases and Insects, Oxford 1964.

2739 Kobayashi, T. 1985. **Diseases in tropical forest nurseries (4) Rust**. Tropical Forestry 4: 56-59.

The range of tree species susceptible to rusts, the various species of fungi involved and symptoms are discussed. Discussed rust diseases of teak and *Cedrela*.

2740 Kulkarni, S; Siddaramaiah, A.L. 1979. **Chemical control of powdery mildew of teak**. Current Research 8(11): 192-193.

Sulphur dust was found the most effective in controlling *Uncinula tectona* on 2-yr-old seedlings followed by Baycor, Morestan and Calixin.

2741 Lee, S.S; Maziah, Z. 2001. **History of forest pathology research in Peninsular Malaysia and challenges for the future**. Tropical Forestry Research in the New Millennium: Meeting Demands and Challenges. Proceedings of the International Conference on Forestry and Forest Products Research, 1-3 October 2001, Kuala Lumpur, Malaysia: 210-217. Forest Research Institute Malaysia, Kuala Lumpur.

Challenges in studying the diseases of forest tree species in the country are discussed.

2742 Liao, K.F; Peng, S.F. 1991. **Decay durability of wood material for housing**. Forest Products Industries 10(1): 51-67.

Resistance to decay by *Coriolus versicolor* and *Fomes pinicolor* was tested for copper chrome arsenic-treated and untreated samples of *Tectona grandis*.

2743 Machek, L; Derksen, A.M; Alvarez, R.S. 1997. **Assessment of wood decay in small-scale unsterile soil-bed tests**. International Research Group on Wood Preservation, Sweden, 25-30 May 1997, Document No. 97-20111: 10p.

2744 Machek, L; Militz, H; Sierra-Alvarez, R. 2001. **The use of an acoustic technique to assess wood decay in laboratory soil-bed tests**. Wood Science and Technology 34(6): 467-472.

This study assesses the changes in elastic behaviour and mass loss of different hardwood which include teak exposed to decay in laboratory soil-bed tests. The study shows a high correlation between dynamic and static bending measurements for the species tested at different stages of fungal decay.

2745 Maheswarappa, V; Naik, S.T. 2003. **Studies on rust of teak - inoculation and survival of uredospore**. Journal of Agricultural Science, Karnataka 16(1): 144-146.

2746 Maziah, Z; See, L.S. 1999. **Diseases and disturbance of teak seedlings and plantations in Peninsular Malaysia**. (Malay). FRIM Technical Information Handbook 26: 20p. Forest Research Institute Malaysia, Kuala Lumpur.

An account is given of fungal and bacterial diseases of teak in Peninsular Malaysia.

2747 Mehrotra, M.D. 1996. **Some destructive nursery diseases and their management**. Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium, Peechi, 23-26 November 1993: 143-152. K.S.S. Nair; J.K. Sharma; R.V. Varma, Eds. Kerala Forest Research Institute, Peechi.

Disease surveys were conducted in forest nurseries established under social forestry, farm forestry and agroforestry in western Uttar Pradesh and Haryana States. The species covered include *Tectona grandis*. Chemotherapy was found to be helpful in controlling the serious diseases and minimising the damage to the nursery stock.

2748 Mitchell, B.A. 1962. **Bacterial wilt in teak, *Tectona grandis* Linn.f.** Malaysian Forester 25(2): 164-166.

Records the outbreaks of wilt in teak seedlings in nurseries in Kedah and Perlis. Improved drainage and reduced weeding and soil cultivation are recommended as preventive measures.

2749 Mohanan, C; Ratheesh, N; Laya P.Nair; Rajesh Kumar. 2003. **Disease problems and their management in teak root trainer nurseries Kerala, India**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

A disease survey was carried out in central nurseries in the state and root trainer nurseries raised by KFRI. The study revealed that root trainer seedlings were almost free from soil-borne fungal diseases like damping-off, web blight, seedling blight, wilt, collar rot, etc. which were most prevalent in conventional nurseries and caused severe damage to the seedling crop. The common nursery pathogens of teak like *Rhizoctonia solani*, *Pythium* spp., *Fusarium* spp., *Sclerotium rolfsii*, etc. seldom recorded in root trainers.

2750 Mohanan, C; Sharma, J.K; Florence, E.J.M. 1997. **Nursery diseases of teak in India**. Teak: Proceedings of the International Teak

Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 107-113. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Poor seedling emergence continues to be the major constrain in teak nurseries. Seedling collar rot and wilt caused by *Pseudomonas solanacearum* are the most important diseases recently reported from Kerala. Foliage rust caused by *Olivea tectonae* is widespread in teak nurseries. Severe rust infection causes leaf blight and premature defoliation and consequently affects the seedling growth. The paper discusses the current status of teak nursery diseases in India and suggests possible control measures and nursery techniques to be adopted for raising healthy teak seedling.

2751 Momoh, Z.O. 1973. **The root rot of teak (*Tectona grandis*) and its control**. Savanna Series, Federal Department of Forest Research, Nigeria, Research Paper 15: 17p.

Discusses measures to control attack by *Rigidoporus lignosus* in young teak plantations in Nigeria, and reports promising results of applying 2 percent Tillex fungicide to the root-collars of affected trees.

2752 Momoh, Z.O. 1976. **Status of root rot disease of teak (*Tectona grandis* Linn.f.) in Nigeria**. PANS 22(1): 43-48.

Root disease is caused by *Rigidoporus lignosus*, sporocarps of which have been found in the infected plantations. Disease incidence is more serious in shallow lateritic soils and sites with impeded drainage. Disease can be largely reduced by careful site selection and pre-treatment of stumps left behind after land clearing.

2753 Momoh, Z.O; Esuruoso, O.F. 1975. **The root rot of teak (*Tectona grandis* Linn.f.) in Nigeria: A survey for the disease**. Nigerian Journal of Forest Research 5(1/2): 42-46.

2754 Momoh, Z.O; Odeyinde, M.A. 1977. **The control of the root rot disease of teak (*Tectona grandis* Linn.f.) in Nigeria**. Forest Series, Forestry Research Institute of Nigeria, Research Paper 34: 16p.

After application of 2 percent Tillex to the root collars of all dead trees, after digging away the surface soil, resulted in a significant reduction in the disease.

2755 Mulder, J.L; Gibson, I.A.S. 1973. ***Olivea tectonae***. CMI Descriptions of Pathogenic Fungi and Bacteria 365: 2p.

The fungus causes a leaf rust of teak.

2756 Neergaard, P. 1977. **Seed pathology Vol.1**. The Macmillan Press Limited, London.

2757 Nema, A.G. 1992. **Bacterial wilt of teak (*Tectona grandis* Linn.f.) in Madhya Pradesh**. JNKVV Research Journal 26(2): p77.

Seedlings of teak displaying wilt symptoms were collected in a survey of forest nurseries in Madhya Pradesh. The causal agent of this disease was identified as *Pseudomonas tectonae*.

2758 Odeyinde, M.A. 1973. **Assessing forest disease problems**. Federal Department of Forest Research, Nigeria, Research Paper Forest Series 15: 5p.

Discusses the problem of assessing and evaluating a forest disease problem, with particular reference to root and butt rot of teak.

2759 Pande, A; Rao, V.G. 1995. **The genus *Rosellinia* (Sphaeriales) from Peninsular India**. Czech Mycology 48(3): 177-182.

Reported the new record of *Rosellinia dimidiata* on *Tectona grandis* from India.

2760 Pawsey, R.G. 1970. **Forest diseases in Trinidad and Tobago with some observations in Jamaica**. Commonwealth Forestry Review 49(1): 64-77.

Gives a general account of forest diseases in Trinidad and Tobago which include those of *Tectona grandis*.

2761 Pegler, D.N; Waterston, J.M. 1968. ***Rigidoporus zonalis***. C.M.I. Descriptions of Pathogenic Fungi and Bacteria, London 200: p2.

Causes white pocket rot of different species including *Tectona grandis*.

2762 Prasad, V; Pant, D.C. 1999. **Two new records of sarcoscyphaceous fungi from India**. Journal of Mycopathological Research 37(1): 9-11.

Acervus epispartius was found for the first time in India on wet manured soil mixed with forest litter under pure teak forest.

2763 Ramakrishnan, T.S; Ramakrishnan, K. 1949. ***Chaconia tectonae* Ramakrishnan T.S. and K. sp. nov. on teak**. Indian Phytopathology 2(1): 17-19.

Describes a new rust commonly found on *Tectona grandis* in the forests of Malabar and Coimbatore.

2764 Ramesh, K.R. 2000. **Inhibition of *Rhizoctonia solani* the causal agent for collar rot of teak (*Tectona grandis*) seedlings by fungicides and biocontrol agents in *in vitro* conditions**. Indian Forester 126(3): 284-288.

Among the fungicides, chlorothalonil, methoxyethyl mercury chloride and carbendazim were found the most effective in inhibiting fungal growth. Of the 2 biocontrol agents T. viride MNT-7, followed by T. viride MNT-2, were found the most effective in inhibiting the pathogen growth.

2765 Ramesh, K.R. 2002. **Collar rot disease caused by *Rhizoctonia solani* in teak (*Tectona grandis* Linn.f.) - a new record from the nurseries of Tamil Nadu**. Indian Journal of Forestry 25(1/2): 87-88.

Collar rot in the seedlings of teak, a serious nursery disease caused by *Rhizoctonia solani* anamorph of *Thanatephorus cucumeris* is recorded for the first time from Tamil Nadu. An account is given on the disease symptoms, pathogenicity test and isolation of casual organism.

2766 Ramesh, K.R. 2002. **Control of collar rot of teak seedlings by some selected fungicides and biocontrol agents through soil application**. Indian Journal of Forestry 25(1/2): 154-157.

Chemical and biological control of collar rot disease of teak caused by *Rhizoctonia solani* anamorph of *Thantephorus cucumeris* is discussed in this paper. Emisan-6, Indofil M-45 and Bavistin were found effective in controlling the disease. Biocontrol agents Trichoderma viride MNT-7 also found to be effective.

2767 Ramesh, K.R. 2002. **Studies on the control of collar rot disease caused by *Rhizoctonia solani* in teak (*Tectona grandis*) by seed treatment**. Journal of Tropical Forest Science 14(3): 357-363.

Seed treatment with fungicides Emisan-6, Indofil M-45 or Bavistin reduced the collar rot of teak seedlings. Biological control agent Trichoderma viride MNT-7 reduced the collar rot disease.

2768 Rao, R; Modak, C.D. 1974. **Saprophytic fungi on *Tectona grandis* Linn.f.** Journal of the University of Poona, Science and Technology 46: 111-114.

2769 Roldan, F.E; Andres, P.P. 1953. **Bacterial wilt of teak seedlings (*Tectona grandis* Linn.f.)**. Philippine Journal of Forestry 9(1/4): 133-143.

A description of the disease is given. The causal organism is provisionally named *Pseudomonas tectonae* sp. nov.

2770 Saksena, S.B; Vyas, K.M; Saxena, R.K. 1974. **Physiology of *Tectona grandis* leaves infected with *Uncinula tectonae* Salmon**. Journal of the Indian Botanical Society 53(3/4): 265-270.

The effects of pathogenesis on free amino acids, sugars and organic acid contents of teak leaves are described and the results discussed.

2771 Salmiah, U; Jones, E.B.G. 2001. **Occurrence of wood inhabiting fungi in forests of Peninsular Malaysia**. Journal of Tropical Forest Science 13(2): 237-245.

Species richness indices showed that Pasoh Forest Reserve had the highest diversity of wood decay mycota followed by FRIM, Jeram Lenang, Kemasul, Mata Ayer and Ulu Sedili. Some wood decaying fungi occurred on the wide range of woody substrata which included twigs, branches and trunks.

2772 Salmiah, U; Jones, E.B.G; Watling, R. 2002. **The distribution of wood inhabiting fungi in Peninsular Malaysia**. Journal of Tropical Forest Science 14(4): 433-440.

A total of 54 species assigned to 29 genera was recorded. *Earliella scabrosa, Lenzites elegans, Microporus xanthopus, Pycnoporus sanguineus, Schizophyllum commune* and *Trametes feei* were amongst the wood-inhabiting fungi present at all sites examined.

2773 Sharma, J.K; Florence, E.J.M; Mohanan, C. 1997. **Current status of diseases in teak plantations in India and future research needs**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 100-106. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

The current status of diseases in teak plantations in India is evaluated under three broad categories viz., diseases of wider occurrence, serious diseases of restricted occurrence and potentially serious diseases. Future research needs which may fulfill the existing gaps in information and importance of monitoring the disease situation regularly in managing the plantations are highlighted.

2774 Sharma, J.K; Mohanan, C; Florence, E.J.M. 1984. **Two mycelia sterilia parasitic on foliage of hardwood seedlings in Kerala State, India**. Transactions of the British Mycological Society 83(2): 342-343.

Teak is a new host of *Sclerotium rolfsii* which cause leaf spot on teak.

2775 Sharma, J.K; Mohanan, C; Florence, E.J.M. 1985. **Disease survey in nurseries and plantations of forest tree species grown in Kerala**. KFRI Research Report 36: 275p. Kerala Forest Research Institute, Peechi.

Details are given of the occurrence, symptoms, etiology, pathogenicity and control of diseases of forest trees including *Tectona grandis*. The results of the survey are discussed and lists of fungicides evaluated against various pathogens, cultural and morphological characters of fungal and bacterial pathogens, and a list of pathogens and their hosts are appended.

2776 Sharma, V; Mehrotra, M.D. 1992. ***Meloidogyne* spp. - cause of root knot of important forest tree species in nurseries**. Indian Forester 118(12): 961-962.

During forest disease surveys conducted in nurseries in and around Dehra Dun, Uttar Pradesh, root knot nematodes were identified causing galling and poor growth in important tree species including *Tectona grandis*.

2777 Singh, S; Bakshi, B.K. 1964 . **Notes on some Indian tree rusts**. Indian Forester 90(7): 469-472.

Notes on the leaf and pod rusts on Indian trees are given which include *Olivea tectonae* of *Tectona grandis*.

2778 Singh, S; Tewari, R.K. 1970. **Role of a precursor fungus in decay in standing teak**. Indian Forester 96(12): 874-876.

Studied the effect of *Phialophora* sp. on the decay of inner heartwood by *Fomes lividus, Polyporus zonalis* and an unidentifed teak rot fungus.

2779 Soni, K.K; Dadwal, V.S; Jamaluddin. 2004. ***Phomopsis* causing canker in flowering twigs of teak**. TEAKNET Newsletter 32: 1-3.

Reported the canker disease of teak caused by *Phomopsis tectonae* observed in the flowering twigs of teak plantations at Jabalpur and adjoining areas.

2780 Soni, K.K; Jamaluddin. 1998. **Teak nursery diseases**. TEAKNET Newsletter 9: 3-4.

2781 Soni, K.K; Jamaluddin. 2002. ***Amylosporum campbellii* (Berk) Ryv. - a new root rot of teak from India**. TEAKNET Newsletter 27: 5-6.

2782 Srivastava, H.P. 1971. **New records of some Ascomycetes**. Indian Phytopathology 24(4): 828-833.

Records include *Podospora nannopodalis* on teak.

2783 Thirumalachar, M.J. 1949. **Telia of the leaf rust on teak**. Current Science 18(5): 175-177.

The structure of the uredia and telia of teak leaf-rust (*Uredo tectonae*) indicates that it is a species of *Olivea* and the rust is renamed *O. tectonae*.

2784 Thite, A.N; Chavan, P.D; Karadge, B.A. 1980. **Some biochemical changes in teak leaves infected with powdery mildew fungus**. Indian Journal of Mycology and Plant Pathology 10(2): 131-135.

Infection by *Uncinula tectonae* caused considerable decreases in moisture percentage, titratable acidity, total chlorophylls and carbohydrate content. Polyphenol content was increased in infected leaves, and acid phosphatase, amylase and peroxidase activities were stimulated.

2785 Thite, A.N; Patil, C.R. 1985. **Additions to the sooty moulds of Maharashtra - III**. Geophytology 15(1): 82-86.

The fungi described include the new sp. *Clypeolella tectonae* on *Tectona grandis* leaves.

2786 Tiwari, D.P; Rajak, R.C; Nikhra, K.M. 1981. **A new species of *Phomopsis* causing leaf spot disease on *Tectona grandis* Linn.f.** Current Science 50(22): 1002-1003.

P. tectonae is described from teak in Jabalpur causing irregular, greyish brown leaf-spots, with partially embedded pycnidia.

2787 Vanitha, S. 2003. **Occurrence of collar rot of teak caused by *Botryodiplodia theobramae* in Tamil Nadu**. Ecobiol 15(3): p239.

The teak tree was found in sudden wilt and the causal organism of the disease identified as *Botryodiplodia theobromae* at Vinayaga Housing Finance Teak Estate, Hosur, Tamil Nadu.

2788 Yoshimura, M. 1963. **Significance of the interaction between fungal species and test methods in the laboratory decay test**. (Japanese). Journal of Japanese Wood Research Society 9(5): 153-156.

Describes statistically controlled experiments using *Polyporus versicolor* and *Poria monticola* on woods of six tropical species including teak.

Go top

Insect Pests

(See also 0222, 0309, 0831, 3362, 3526, 4129, 4455, 4473, 4475, 4483, 4484, 4506)

2789 **The Tortrix of the teak tree**. Indian Forester 18, 1892: 46-48.

Describes the ravages of attack by larva of a Tortrix in some of the plantations in Burma in 1884, where a complete defoliation of teak was observed.

2790 **Damage to teak logs in ship holds**. Indian Forester 59(1), 1933: 52-53.

The shot hole boring of teak logs attributed to *Dinoderus minutus* is discussed.

2791 **Teak defoliators**. Forest Research in India and Burma 1947/48 Part I, Chapter IV: p38. Government of India Press, New-Delhi, 1948.

2792 **Proceedings of the Fifth Annual Meeting of the Committee for the Protection of Timber against Marine Organisms Attack, Trivandrum, 7-10 March 1960**. Timber Dryers' Preservations Association 6(2), 1960: 1-22.

Includes reports by A. Purushotham outlining the work of Dehra Dun, the Bombay and other Indian wood preservation centres on *Limnoria*, *Teredo* and *Martesia* spp., with particular reference to durability tests on Ascu and creosote treated heartwood specimens of Indian timbers and by A.S. Rawat, summarizing the results of statistical data on toxicity tests with Ascu, creosote, creosote/fuel oil, and PCP preservatives and durability tests on species including *Tectona grandis* at various harbours.

2793 ***Zeuzera coffeae* Nietn. (Lepidoptera, Cossidae) (red twig borer, red Coffee borer)**. Distribution Maps of Pests, A. 313, 1973: 2p.

2794 ***Olivea tectonae* (T.S. and K. Ramakrishnan) Mulder**. Distribution Maps of Plant Diseases 499, 1974: 2p.

On Tectona grandis.

2795 Agboola, D.A; Kadiri, M. 1999. **The effects of defoliation and inorganic fertilisers on the growth of some tropical tree seedlings**. Journal of Tropical Forest Science 11(4): 672-679.

The effects of defoliation and some inorganic fertilizers on the growth of nursery seedlings of tropical tree species including *Tectona grandis* were studied in Nigeria. Seedling height was unaffected by defoliation. An increase in total leaf area and dry weight of seedlings was there when treated with inorganic fertilizers.

2796 Ahmad, M. 1955. **A new termite from East Pakistan (Isoptera, Termitidae)**. Biologia, Lahore 1: 25-27.

Describes a soldier of *Microtermes pakistanicus* sp. nov., found on the bark of teak in the Chittagong Hills.

2797 Ahmad, M. 1989. **Feeding diversity of *Myllocerus viridanus* Fab. (Coleoptera: Curculionidae) from South India**. Indian Forester 115(11): 832-838.

Myllocerus viridanus is a common defoliator of teak in the forests of southern India. It is found that it is causing considerable defoliation to many plant species of forestry importance.

2798 Ahmad, M; Vijayachandran, S.N; Choudhury, J.C.B. 1985. **Biology of *Hestiasula brunneriana* Saussure (Dictyoptera: Mantidae)**. Indian Forester 111(5): 333-338.

H. brunneriana seems to be an effective predator on various defoliating insect pests including *Hyblaea puera* and *Eutectona machaeralis*. A study was made of various aspects of its life history.

2799 Aisagbonhi, C.I. 1987. **Damage to teak (*Tectona grandis* Linn.f.) leaves by nymphs of *Zonocerus variegatus* Linn., (Acridoidea: Pyrgomorphidae) at Ibadan, Nigeria.** Nigerian Journal of Entomology 8(1/2): 99-102.

Early-instar nymphs of the acridid *Zonocerus variegatus* are reported skeletonizing the leaves of *Tectona grandis* in Nigeria.

2800 Ali, M.S; Alam, T; Kumar, M; Chatruvedi, O.P. 2002. **Studies on seasonal incidence of *Eutectona machaeralis* Walker on teak seedling stock**. Indian Journal of Agroforestry 4(1): 79-80.

Seasonal incidence and level of infestation caused by different instars of *Eutectona machaeralis* in nursery stock was studied. Rainfall, minimum temperature, relative humidity had significant positive correlation on larval population of the pest on teak seedlings in north Bihar, India.

2801 Ali, M.S; Alam, T; Sattar, A. 2002. **Studies on population fluctuation of *Eutectona machaeralis* Walker on teak saplings in north Bihar**. Shashpa 9(2): 139-142.

Weather and population fluctuation data showed that weather had a significant influence on pest population build-up. Rainfall, minimum temperature and relative humidity had significant positive correlation with pest population.

2802 Ali, M.S; Chaturvedi, O.P. 1996. **Major insect pests of forest trees in north Bihar**. Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium, Peechi, India, 23-26 November 1993: 464-467. K.S.S. Nair; J.K. Sharma; R.V. Varma, Eds. Kerala Forest Research Institute, Peechi.

Insect pests and disease causative pathogens affecting seedlings and plantations of forest trees including *Tectona grandis* are enumerated.

2803 Alphen De Veer, E.J Van. 1956. **The occurrence of *X. destruens* in teak plantations in Java**. (Javanese). Rimba Indonesia 5(7/8): 387-408.

Discusses the nature of the damage to timber. Recommends suspension of teak planting in infested areas and in other areas too wet for teak and research on the effect of thinnings of different intensity and of an understorey of other species.

2804 Altona, T. 1925. **Damage to teak plantations by ants**. (Indonesian; English). Tectona 18: 755-762.

In the island of Java, young teak trees are observed to be damaged by ant living in trees, *Crematogaster traubi* var.*vastatrix*. The young shoots of leaf stalks are punctured and the pith is digged out causing the death of the young organs.

2805 Amin, P.W; Upadhyaya, A.K. 1976. **Occurrence of teak defoliator, *Hyblaea puera* (Hyblaeidae, Lepidoptera) on the Fountain Tree *Spathodea campanulata* (Bignoniaceae)**. Indian Forester 102(5): 306-311.

The life cycle, host preference and interbreeding were studied. It is concluded that the populations on *S. campanulata* and teak were identical. *S. campanulata*, which is a new host record for *H. puera*.

2806 Amir, M. 1977. **The effect of temperature on the distribution of the teak pest *Neotermes tectonae* Damm. in Java**. (Indonesian). Proceedings of the Fourth Biological Seminar and Second Biological Congress, 10-12 July 1975. Vol. 2: 265-270.

2807 Andrews, E.A. 1920. **Insect pests of tea in North East India during season, 1919**. Indian Tea Association Quarterly Journal 2: 33-34.

Reports on the insect *Zeuzera coffeae* which attacks teak tree also in addition to the tea.

2808 Andrews, E.A. 1921. **Insect pests on tea in North India during the season 1920**. Indian Tea Association Quarterly Journal 1(6).

Reports on the life history and occurrence of the insect *Zeuzera coffeae* which attacks teak also.

2809 Angeles Martinez, M de los; Blanco, E; Perez, I. 2001. **New mealybug hosts of *Dysmicoccus ferris* (Hem., Pseudococcidae) genus in Cuba**. Revista de Proteccion Vegetal 16(2/3): p160.

Teak is one of the species recorded as new hosts for the genus *Dysmicoccus* in Cuba.

2810 Anuwongse, B. 1972. **A species of wood-destroying beetle recently found in Thailand**. (Thai). Vanasarn 30(3): 205-215.

Reports the identification of *Stromatium longicorne* infesting structural timbers including teak sapwood. Prevention of attack by treating inferior structural timber with a conventional preservative is recommended.

2811 Arndt, U. 1968. **Intestinal protozoa of *Reticulitermes* and their suitability for testing wood extractives**. (German). Materials und Organizmen 3(2): 119-126.

In an investigation on the physiology of termite nutrition three micro-organisms were isolated from the gut and cultured. Of these include desoxylapachol from teak.

2812 Arreola Vazquez, M.C. 1980. **Forest protection at the Forest Experiment Station 'El Tormento' (Campeche, Mexico)**. (Spanish). Ciencia Forestal 5(24): 49-58.

Pests of young plantations including teak discussed include *Xyleborus morigerus*.

2813 Atkinson, D.J. 1926. **Some types of teak defoliation**. Indian Forester 52(4): 141-146.

Reports on defoliation by the insects *Hapalia machaeralis* and *Hyblaea puera* in Nilambur as teak feeders. Certain types of defoliation characteristic of particular species of insects are described and illustrated. Skeletonization by *Aularche milliaris* and *Diacrisia obliqua* is also reported.

2814 Atkinson, D.J. 1931. **Insect damage to the timber of teak (*Tectona grandis*)**. Burma Forest Bulletin (Zoology Series) 26(2): 1-11.

The damage caused to teak timber by insect species, important of which are dealt with.

2815 Atkinson, D.J. 1936. **A survey of the damage to teak timber by the bee-hole borer *Xyleutes ceramica* Wlk. throughout the main teak-bearing forests of Burma**. Indian Forest Records (n.s.) Entomology 2(1): 1-98.

Results are presented on a prolonged investigation in the incidence of bee-holing in the main teak plantations of Burma.

2816 Atkinson, D.J. 1936. **Further notes on bee-hole borer *Xyleutes ceramica* in India**. Indian Forest Records (n.s) Entomology 5.

2817 Atkinson, D.J. 1936. **On the biology bee-hole borer *Xyleutes ceramica* Wlk. in Burma**. Indian Forest Records (n.s) Entomology 4.

2818 Atkinson, D.J. 1936. **On the biology of *Hapalia machaeralis* Wlk**. Indian Forest Records (n.s) Entomology 6.

2819 Atkinson, D.J. 1937. **Survey of the damage to teak timber by bee-hole borer *Xyleutes ceramica* Wlk. throughout the main teak bearing forests of Burma**. Indian Forest Records (n.s) Entomology 2.

The investigations include the varying incidence of attack and comparison of incidence as between natural and plantation grown stands.

2820 Atuahene, S.K.N. 1976. **Incidence of *Apate* spp. (Coleoptera: Bostrychidae) on young forest plantation species in Ghana**. Ghana Forestry Journal 2: 29-35.

In plantations species including *Tectona grandis* were affected.

2821 Baksha, M.W. 1990. **Some major forest insect pests of Bangladesh and their control**. Forest Research Institute Chittagong, Bulletin Forest Entomology Series 1: 19p.

Brief descriptions are given of the damage caused by and control methods used for the nursery pests, plantation pests and wood and timber pests of Bangladesh.

2822 Baksha, M.W. 1996. **Attack of teak canker grub, *Dihammus cervinus* Hope (Cerambycidae: Coleoptera) and its control in teak plantations of Bangladesh**. Bangladesh Journal of Forest Science 25(1/2): 37-42.

Characteristics are described of infestation by the teak canker grub, *Dihammus cervinus* in teak plantations in Bangladesh, including the nature and extent of damage, geographical distribution, life history, age of host plants, and control measures.

2823 Baksha, M.W; Crawley, M.J. 1995. **Relative preference of different host plants to teak defoliator, *Hyblaea puera* Cram. (Hyblaeidae: Lepidoptera) in Bangladesh**. Bangladesh Journal of Forest Science 24(1): 21-25.

Seven plant species have been recorded as hosts of the teak defoliator, *Hyblaea puera*, in Bangladesh. The food preference of the pest larvae was evaluated and *Tectona grandis* was found to be the most preferred.

2824 Baksha, M.W; Crawley, M.J. 1998. **Effect of defoliation on the growth of teak**. Journal of Tropical Forest Science 10(3): 312-317.

Four years of manual defoliation caused significant losses of about 14-49 percent in height, 19-51 percent in basal area and 23-62 percent in volume increments depending on the intensity of defoliation compared with the unsprayed control. Loss of volume increment is a serious impact of defoliation.

2825 Baksha, M.W; Crawley, M.J. 1998. **Population dynamics of teak defoliator, *Hyblaea puera* Cram. (Lep., Hyblaeidae) in teak plantations of Bangladesh**. Journal of Applied Entomology 122(2/3): 79-83.

The temporal and spatial distribution of infestation suggested a short-range migration of the moth. When general flushing of teak occurs, the population starts building up generation by generation and when a critical density is reached in a patch, the newly emerged moths migrate to newly flushed teak areas. After one to three peaks, the population declines due to leaf maturity, natural enemies or density-dependent food depletion.

2826 Baksha, M.W; Islam, M.R. 1997. **Major defoliators of teak in Bangladesh and their management**. Bulletin Forest Entomology Series, Bangladesh Forest Research Institute 2: 14p. Bangladesh Forest Research Institute, Chittagong, Bangladesh .

2827 Balakrishnan Nair, N. 1956. **Destruction of timber structure by ship worms in Madras waters**. Journal of Scientific and Industrial Research 15c(3): 81-82.

Bankia admondsonii, attacked hulls of boats, jetty constructions, fishing stakes etc. of teak and *Teredo parksi* - attacked piles and other underwater structures of teak inside harbour.

2828 Balu, A; Rajarishi, R; Deeparaj, B; Durairaj, S. 1997. **Curling and crinkling of teak leaves**. Indian Forester 123(8): 775-777.

Nursery seedlings and young trees of teak in Kerala and Tamil Nadu are attacked annually by a species of leaf hopper. In advanced stages of infestation a secondary association of the pest with the fungal leaf pathogen *Phomopsis* was there.

2829 Banerjee, S. 1975. **Inducing sterility in adult moths of *Hapalia machaeralis* Wlk. (Lepid., Pyralidae) by administering metepa through adult diet**. Zeitschrift fur Angewandte Entomologie 79(1): 48-52.

When the chemosterilant metepa was supplied in their food to adults of both sexes of *Pyrausta machaeralis* (Wlk.), metepa did not affect the duration of adult life, but with access to 1.2-2.5 percent there were toxic effects.

2830 Basalingappa, S; Gandhi, M.R. 1994. **Infestation of the seedlings of *Tectona grandis* by the lepidopteran larvae of *Hapalia machaeralis* (Pyralidae) and *Hyblaea puera* (Hyblaeidae).** Journal of Ecobiology 6(1): 67-68.

Observations of a heavy infestation leading in many cases to total leaf loss, are reported from Barachi nursery in the Western Ghats of Karnataka.

2831 Basu, A.C. 1943. **Effect of different foods on the larval and post-larval development of the moth *Prodenia litura* Fab**. Journal of the Bombay Natural History Society 44: 275-280.

2832 Beekman, H; Beumee, J.G.B; Kalshoven, L.G.E. 1919. **Injuries and diseases in trees**. Meded Proefsta Boschw 4: 82p. G. Kolff & Company, Satavia.

Contains information about teak borer, *Duomitus ceramicus*, teak termite, *Calotermes tectonae*, bark injuries, red borer, *Zuezera coffea*, red stem borer, *Zeuzera postexcit*a and ring borer, *Phassus* spp.

2833 Beeson, C.F.C. 1918. **Forest insect conditions in India**. Indian Forester 44(12): 587-591.

Gives notes on Sahayadrassus malabaricus, Hyblaea puera, Hapalia machaeralis and Xyleutes ceramica.

2834 Beeson, C.F.C. 1919. **The food plants of Indian forest insects**. Indian Forester 45(6): 312-323.

Along with other insect lists, *Alcides ludificator*, sapling borer, *Arisobia birmanica, Glenea galathea* and *Glenea indiana*, etc. and several other insects and defoliators.

2835 Beeson, C.F.C. 1920. **Some problems in forest insect control**. Proceedings of Third Entomological Meeting: p696, 704. Government of India, New Delhi.

2836 Beeson, C.F.C. 1921. **Defoliation of teak trees**. Indian Forester 47(6): 269-270.

2837 Beeson, C.F.C. 1921. **Beehole borer of teak. Preliminary note on the ecology and economic status of *Duomitus ceramicus* Wlk. in Burma (Lepidoptera: Cossidae)**. Indian Forest Records 8(3) (Old Series) Entomology: 105p.

2838 Beeson, C.F.C. 1925. **The teak canker grub-*Dihammus cervinus***. Indian Forester 51(5): 187-192.

The paper describes distribution, life history damage caused by the pest and also recommends control measures.

2839 Beeson, C.F.C. 1928. **The defoliation of teak**. Indian Forester 54(4): 204-215.

2840 Beeson, C.F.C. 1930. **Loss of increment in teak defoliation**. Indian Forester 57(11): 540-545.

2841 Beeson, C.F.C. 1931. **Loss of increment in teak defoliation**. Indian Forester 60(10): 672-683.

2842 Beeson, C.F.C. 1941. **The ecology and control of the forest insects of India and the neighbouring countries**. Vasant Press, Dehra Dun: 1007p.

A systematic record of available information on the ecology of insects related to Indian forests. The information is arranged alphabetically by orders and then families of insects, each species is dealt with separately. A brief description is given for each species, a list of hosts, life history and nature of the damage and its economic importance. The second part deals with control. Seven types of control are distinguished, climatic, nutritional, biotic and silvicultural, biological, mechanical and chemical. The last part of the book deals with specific control measures for each type of insect.

2843 Bhowmik, A.K; Vaishampayan, S.M. 1986. **Observations on the activity of teak defoliator *Hyblaea puera* Cramer on teak (*Tectona grandis*) influenced by the movement of monsoon**. Journal of Tropical Forestry 2(1): 27-35.

It is indicated that *H. puera* is a strongly migratory moth and its activity was closely linked with the movement of the SW monsoon. The first appearance of the moth was within 2 days of the arrival of the monsoon. Delay in the arrival of the monsoon in E. Madhya Pradesh reduced pest activity in proportion to the delay.

2844 Bhowmik, A.K; Vaishampayan, S.M. 2001. **Effect of elevation on light trap catches of *Hyblaea puera* Cramer and *Pyrausta machaeralis* Walk. in the teak forest at North Mandla**. JNKVV Research Journal 35(1/2): 87-88.

A light trap was installed 50 m above ground level in Madhya Pradesh to determine the effect of elevation on light trap catches of *Hyblaea puera* and *Pyrausta machaeralis*.

2845 Bigger, M. 1980. ***Hyblaea puera* on teak**. Forest Pests of the Solomon Islands, Forestry Division, Solomon Islands 5: 3p.

A brief account is given of the biology, life cycle, control and distribution of the species. The population is generally kept in check by a number of natural enemies.

2846 Bingham, C.T. 1894. **Note on the pests of a teak tree**. Indian Forester 20: 22-24.

Describes damages caused by insects-*Hyblaea puera* and *Paliga damastesalis* in Burma.

2847 Bourdillon, T.F. 1889. **A teak borer in Travancore**. Indian Forester 15: 252-253.

2848 Bourdillon, T.F. 1898. **Insects attacking teak in Southern India**. Indian Forester 24: 126-127.

2849 Campbell, W.G; McGowan, J.C. 1939. **The composition and origin of a stony deposit found in galleries of the beehole borer in a number of samples of teak wood (*Tectona grandis* Linn.f.)**. Empire Forestry Journal 18(1): 91-94.

The approximate composition of the deposit is 8 percent moisture, 55 percent resinous organic material and 36 percent calcium hydrogen phosphate. The origin of the deposit is probably the tree sap from which water is evaporated.

2850 Canadian Forestry Service, Ontario. 1982. **Effects of insects and diseases on cone and seed storage**. Proceedings of the International Symposium on Forest Tree Seed Storage: 98-135. Canadian Forestry Service, Chalk River, Ontario.

Out of three papers one paper was on teak. Sharma, J.K., Mohanan, C. Spermoplane microflora of stored seeds of *Tectona grandis*, *Bombax ceiba* and *Eucalyptus* spp. in relation to germinability. 107-125.

2851 Cann, F.R. 1939. **A further instance of the occurrence of a stony deposit in insect tunnels in a sample of teak**. Empire Forestry Journal 18: p268.

A stony deposit from tunnels of *Xyleutes ceramica* was found in pin-holes typical of Scolytid and Platypodid boring beetles in a sample of Siamese teak.

2852 Chakravarthy, A.K; Puttarangappa, S. 2003. **Unusual occurrence of teak defoliator on cotton in Southern Karnataka**. Insect Environment 9(3): p119.

It is reported that *Hyblaea puera* is defoliating tender leaves of cotton in Karnataka.

2853 Champion, H.G. 1934. **The effect of defoliation on the increment of teak saplings**. Indian Forest Bulletin 89, 1934: 6p.

The experimental results indicate that the three defoliation in the first season caused sixty to seventy percent loss of the normal increment, and a fourth defoliation increased it to 65-70 percent. Defoliation in the second season caused further loss and reduced power of recovery.

2854 Champion, H.G. 1935. **The effect of defoliation on the increment of teak saplings**. Indian Forester 61(2): p121.

Lepidopterous larvae-*Hapalia machaeralis* and *Hyblaea puera* cause death of saplings from repeated defoliation and skeletonising, but in large trees death rarely occurs. The paper describes and discusses effect of defoliation on increment of teak.

2855 Chang, L; Wu, W.J; Hsu, E.L. 2002. **The food preference of the Formosan subterranean termite, *Coptotermes formosanus* (Isoptera: Rhinotermitidae)**. (Chinese). Plant Protection Bulletin, Taipei 44(2): 135-139.

2856 Chatopadhyay, S. 2000. **Observation on the feeding habit of the teak defoliator, *Hyblaea puera* Cramer (Hyblaeidae: Lepidoptera)**. Journal of Interacademicia 4(1): 183-185.

As a result of heavy infestation 89.68 percent and 91.93 percent of seedlings were of no use in the years 1998 and 1999, respectively. A brief account of the behaviour of *Hyblaea puera* is also given.

2857 Chatterjee, P.N; Sebastian, V.O. 1965. **The feeding habits of larvae of *Hapalia machaeralis*, the teak leaf skeletonizer on the leaves of *Lantana camara* Linn., and a suggestion for evolving a new insecticide**. Indian Forester 91(3): 200-202.

Experiments with larvae of this insect showed that, in the absence of teak leaves, first and second instars refused to eat Lantana leaves, and died of starvation. Some larvae of the third and fourth instars ate Lantana leaves, but most of them died later. It is suggested that further research should be done on the possible insecticidal or repellent constituents in *L. camara* leaves.

2858 Chatterjee, P.N; Sen Sarma, P.K. 1968. **Important current problems of forest entomology in India**. Indian Forester 94(1): 112-117.

The present position of teak defoliation and possible control measures have been discussed.

2859 Chatterjee, S.N. 1932. **Identification of teak defoliators in the field**. Indian Forester 58(12): 689-691.

A note is given to identify the more important defoliators of teak in field.

2860 Chatterjee, S.N. 1941. **On the nomenclature and seasonal forms of *Hapalia machaeralis***. Indian Journal of Entomology 3(2): 177-178.

2861 Chaudhry, G.U. 1954. **Some problems of forest entomology in Pakistan**. Pakistan Journal of Forestry 4(4): 241-251.

Include brief notes on pests of teak also.

2862 Chaudhry, M.I; Ahmad, M; Malik, N.K; Akhtar, M.S; Arshad, M. 1972. **Termites of Pakistan. Identity, distribution and ecological relationship**. 154p. Pakistan Forest Institute, Peshawar, Pakistan.

Observations on the nests, feeding habits and swarming are provided for the species observed and the distribution of some genera is discussed in relation to climate and altitude. In laboratory investigations on the resistance of common timbers to attack by insects, *Tectona grandis* is found highly resistant.

2863 Chavan, M.R; Kumar, P. 1998. **Gall midge, *Asphondylia tectonae* Mani (Cecidomyiidae: Diptera) threat to teak**. Indian Journal of Forestry 21(4): p366.

The occurrence of the gall midge, *Asphondylia tectonae* was observed in a clonal teak seed orchard and in teak plantations around Sirsi in Karnataka. The adult insects and galls are briefly described. Some of the seed orchard clones exhibited resistance to the gall midge while others were 100 percent infested.

2864 Chen, Z.Q; Wu, S.X. 1984. **Preliminary observations on *Hyblaea puera* Cramer**. Insect Knowledge Kunchong Zhishi 21(4): 161-163.

Preliminary observations on the biology of *Hyblaea puera*, an important pest of teak in Guangdong, Yunnan and Hubei Provinces and Taiwan, are described. The egg, larva, nymph and adult are described.

2865 Cheriyan, P.V. 1964. **Vertical distribution of Crustacean and Molluscan wood borers on submerged structures in Cochin harbour**. Journal of Timber Dryers' Preservers Association, India 10(2): 26-36.

Range and intensity of attack by *Martesia* spp., *Sphaeroma* spp., and *Teredo* spp., observed on marine piling of including *Tectona grandis*, after about 5 years service.

2866 Cherrett, J.M; Peregrine, D.J. 1976. **A review of the status of leaf cutting ants and their control**. Association of Applied Biologists: Proceedings of the Association of Applied Biologists. Tropical pests. Annals of Applied Biology 84: 124-128.

Tables are given showing the distribution in the Americas of 14 species of Atta and 23 species of Acromyrmex and the importance of leaf-cutting ants as pests of agriculture, forestry and range plants. Types of plants susceptible to damage by these ants are listed, and information on distribution, crops damaged, economic importance and control are briefly reviewed.

2867 Chey, V.K. 2000. **Insect pests of teak**. Proceedings of the Seminar on High Value Timber Species for Plantation Establishment - Teak and Mahoganies, Sabah, 1-2 December 1998. JIRCAS Working Report 16: 59-66. H.H. Chan; K. Matsumoto, Eds.

The four major insect pests of teak in Sabah are identified as *Xyleutes ceramica*, *Endoclita aroura*, *Paliga damastesalis* and *Hyblaea puera*. The amount of damage and control methods are discussed. It is reported that the trend is to move from sole reliance on chemical control to a more integrated approach incorporating silvicultural, biological, and pheromone attractant measures.

2868 Chey, V.K. 2002. **Major insect pests and their management in forest plantations in Sabah, Malaysia**. Proceedings of the IUFRO FAO workshop on Pest management in tropical forest plantations, Chanthaburi, Thailand, 25-29 May 1998. C. Hutacharern; B. Napompeth; G. Allard; F.R. Wylie, Eds. FORSPA-Publication 30: 19-23. FAO Regional Office for Asia and the Pacific, Bangkok.

The major tree species planted are fast-growing exotics which include *Tectona grandis*. The establishment of these single species plantations is affected by defoliating insects, termites, pinhole borers and cerambycid and cossid stem borers. This paper focuses on the more important insect pests, the damage and control methods.

2869 Chinniah, C; Senguttuvan, T; Varma, R.V. 1998. **Morphometric discrimination of larval instars of teak defoliator, *Hyblaea puera* Cramer**. Insect Environment 4(3): p77.

The head capsule widths of the 5 larval instars of *H. puera* were measured and are given.

2870 Choldumrongkul, S. 1987. **Influence of soil composition and some properties of teak tree on the infestation of teak beehole borer, *Xyleutes ceramics* Walker**. Kasetsart University, Bangkok: 54 leaves.

Studies on the influence of soil composition and some properties of teak tree on the infestation of the teak beehole borer, *Xyleutes ceramics* Walker, were carried out. A total of 18 factors were studied which influence the infestation of the teak beehole borer. The factors were arranged from high to low correlation as follows: pH, alcohol-benzene extractives, G.B.H., manganese, thickness of the teak bark, bark hardness, percentage of clay, calcium and sodium respectively.

2871 Choldumrongkul, S; Hutacharern, C. 1988. **Possibility of using light traps to estimate the population of the teak defoliators**. Thai Journal of Forestry 7(1): 28-36p.

Estimation of the population density of the teak defoliators by using light traps at Khaobin teak forest in Ratchaburi province found the number of *Hyblaea puera* Cramer was much less than *Eutectona machaeralis* Walker. The result indicated that light trap was possible to use as one of the tools to estimate the population of *E. machaeralis*.

2872 Choldumrongkul, S; Polwicha, P. 1992. **Effect of mixed plantation of teak and eucalyptus on the outbreak of teak beehole borer**. Proceedings of the Seminar on 50 Anniversary of Huay-Tak Teak Plantation, Thailand, 5-8 August, 1992. Royal Forestry Department, Bangkok.

Effect of mixed plantation of teak and eucalyptus on the outbreak of teak beehole borer was studied in three plantations. The damage rate and population density were low in the mixed stands and were significantly different from those in the pure stands.

2873 Cobbinah, J.R. 1972. ***Hypothenemus pusillus*, a shoot borer of *Tectona grandis*, *Terminalia invorensis*, *Cedrela odorata* and *Gmelina arborea***. Ghana Forestry Department Planning Branch Entomology Report 2.

2874 Cores, E.C. 1889. **Teak caterpillar (*Hyblaea puera*)**. Indian Museum Notes, Calcutta 1: 52-53.

2875 Creffield, J.W; Thornton, J.D; Johnson, G.C; Nguyen, N.K. 1993. **An in-ground natural durability field test of Australian timbers and exotic reference species. IX. Termites and decay on hardwoods at the Walpeup site between 18 and 23 years after installation**. Materials und Organismen 28(3): 209-235.

Hardwood specimens including teak remaining at the Walpeup site in Australia were inspected for presence of termites and decay at yearly intervals. Termites numbers did not vary significantly. Soft rot was common whereas brown rot was rarely detected.

2876 Cubbit, G.E.C. 1901. **Life history of *Hyblaea puera***. Indian Forester 27(8): p422.

Reports on damage in Yemi Reserve, Pyinmana, Upper Burma, by *H. puera*. It is suggested that the insect pupates in any dense tree or shrubs or fallen leaves when undergrowth is absent. Tallest teak trees only are attacked while poles and saplings escaped and the injury is confined to upper branches.

2877 Dabral, S.L; Amin, P.W. 1975. **Poor fruit formation in teak in Chanda forests of Maharastra**. Indian Forester 101(10): 616-620.

Studies which showed that attack by larvae of *Pyrausta machaeralis* on flowers, calyces and newly set fruits of *Tectona grandis* was the cause of the trouble. Brief notes are given on the damage caused and on the life history, ecology and habitats of *P. machaeralis*; control measures are suggested.

2878 David, B.V; Sundararaj, R; Regu, K. 1991. **On four new species of *Odontaleyrodes* Takahashi (Aleyrodidae: Homoptera) with a key to Indian species**. Journal of Insect Science 4(2): 117-119.

A key to the Indian species of the genus *Odontaleyrodes* is provided. Out of four new species described O. splendens is collected from *Tectona grandis* in Kerala.

2879 Dawkins, C.G.E. 1921. **Notes on an attack of *Pyrausta machaeralis* on teak in Zogon and Tharrawaddy Division in 1920**. Indian Forester 47(5): 209-213.

Describes preliminary observations on the attack and observes that rain result in severe defoliation.

2880 Dhanarajan, G. 1976. **Some observations on the teak collar ring borer - *Endoclita gmelina* (Lepidoptera: Hepialidae) in north western Malaysia**. Malaysian Forester 39(4): 214-223.

Endoclita gmelina is a pest of some importance in experimental teak plantations in West Malaysia, and detailed information is given on its bionomics and the type of damage caused. The damage was usually confined to saplings and sometimes resulted in death. Preventive control measures suggested comprise the removal of Lantana and Eupatorium plants and the application of tanglefoot to the base of the young trees where attack normally begins.

2881 Dun, G.S. 1955. **Economic entomology in Papua and New Guinea, 1948-1954**. Papua New Guinea Agricultural Journal 9(3): 109-119.

Minor trials have been made in the protection of young seedlings which include the control of the teak moth, *Hyblaea puera*, with DDT and BHC.

2882 Edwards, J.P. 1953. **Other injurious insects**. Report of Forest Administration, Malaya 14.

Cossid moths were found attacking the boles and branches of young saplings and older tree of species including *Tectona grandis*.

2883 Eluwa, M.C. 1979. **Biology of *Lixus camerunus* Kolbe (Coleoptera: Curculionidae): A major pest of the edible vernonias (compositae) in Nigeria**. Revue de Zoologie Africaine 93(1): 223-240.

L. camerunus is also known to attack the young foliage of economically valuable trees such as *Tectona grandis*.

2884 Eungwijarnpanya, S; Hedlin, A.F. 1984. **Studies on seed insects of some forest trees**. Embryon 1(1): 49-55. ASEAN Canada Forest Tree Centre, Saraburi, Thailand.

Preliminary observations are reported on damage caused by various insect species to seeds of eleven species including *Tectona grandis* of Thailand.

2885 Ferguson, J.H.A. 1949. ***Xyleborus destruens* in teak**. (Dutch). Tectona 39(4): 387-389 .

Summarized existing information on *X. destruens* damage to teak, and concludes that this borer occurs mainly in wet climates at high altitudes, where teak should not be planted.

2886 Fernandez, E.E. 1898. **A teak defoliator in the Central Provinces**. Indian Forester 24: p428.

2887 Fernandez, E.E. 1898. **Defoliation of teak in Central Provinces**. Indian Forester 24: p89.

2888 Fernando, S.N.U. 1965. **Insects commonly found in the teak nurseries of Ceylon**. Ceylon Forester 7(1/2): 54-56.

Notes on the seed borer, *Lasioderma serricorne*; skeletonizer, *Hapalia machaeralis*; root destroyer, *Oryctes rhinoceros*; defoliators, *Hyblaea puera* and *Aularches miliaris* and several aphids are given.

2889 Fletcher, T.B. 1914. **Some South Indian insects**. Government of India Press, Calcutta.

Gives accounts of insects damaging teak, mainly the red borer, *Zeuzera coffeae* and leaf skeletonizer, *Hyblaea puera*.

2890 Forest Department, Andhra Pradesh. 1965. **Annual report of the Soil Conservation Research Centre, Hyderabad**. Central Soil Conservation Research, Training and Demonstration Centre, Hyderabad, Annual Report 1964-65. Forest Department, Andhra Pradesh.

Gal formation was noticed in *Tectona grandis* caused by a Dipterous insect, *Itonididae cecidmemyildal*.

2891 Forest Department, Burma. 1932. **Tests in the Rangoon river on the damage by marine borers to various woods including Burma teak and British Guina Green-heart, cresoten and untreated**. Burma Forest Bulletin 28.

2892 Forest Department, Burma. 1936. **On the insect *Alcides ludificator***. Progress Report, Forest Administration, Burma 1935-36: p35.

2893 Forest Department, Burma. 1949. **Inderbela: Life history and alternate hosts**. Report of Working Plans Silviculture Entomology, Forest Department Burma 1940-41, 1948: 78-80.

This pest is an alternate host of *Nemeritis tectonae*, a parasite of bee-hole borer, hence considered important. Its polyphagous habits are likely to be of considerable assistance in establishing *Nemeritis tectonae*.

2894 Forest Department, Burma. 1949. **Pests of teak: *Xyleutes ceramica* Walk., the beehole borer**. Report of Working Plans Silvicultural Entomology, Forest Department, Burma 1940-41: 69-76 .

Life history and natural enemies.

2895 Forest Products Research Board, London. 1952. **Electro-chemical attack on boat-timbers**. Report of Forest Products Research Board, London 1952: 42-46.

Teak is one of the timbers studied.

2896 Gandhi, S.S; Pajni, H.R. 1988. **On two new species of genus *Indomecus* Pajni and Gandhi (Tanymecini, Brachyderinae, Curculionidae)**. Annals of Entomology 6(1): 7-12.

Indomecus bombayensis and *I. brevimandibularis* are described. *I. bombayensis* was collected from *Tectona grandis*. A key to species of the genus *Indomecus* is provided.

2897 Gardner, J.C.M. 1943 . **Entomological notes**. Indian Forester 69: 323-324.

Brief notes are included on termites in India and on a plan to maintain certain plants as undergrowth in teak forests in order to act as hosts to parasites of teak defoliators.

2898 Gardner, J.C.M. 1944. **A note on the imported lantana bug (*Teleonemia scrupulosa* Stal.)**. Indian Forester 70: 139-140.

Investigations on the Lantana bug were carried out at Dehra Dun in order to determine its reactions to the local climate, its effect on lantana and on other Verbenaceae such as teak. Once the lantana had been defoliated the bugs migrated to teak leaves, where they were able to feed and reproduce rather less rapidly.

2899 Gardner, J.C.M. 1944. **Young trees and *Phassus* borers (Lepidoptera: Hepialidae)**. Indian Forester 70(4).

2900 Garthwaite, P.F. 1940. **A guide to the borers of commercial timbers of Burma (cf. to *Xyleutes ceramica*)**.

2901 Ghaiglom, D. 1966. **Teak beehole borer and the control research in Thailand**. Vanasarn 24(3): 295-300.

Outlines the biology and ecology of *Xyleutes ceramica* and describes experiments on its control in N. Thailand. The most promising method, tested in 1965, is biological control by inoculation of the pest with the fungus *Beauveria bassiana* by injecting a mix-

ture of dried spores and talc into the holes or dusting the mixture on to the stem surface.

2902 Ghaiglom, D. 1967. **Teak beehole borer-control research in Thailand**. Proceedings of the First Forestry Conference, Royal Forest Department, Ministry of Agriculture, Bangkok R.107: 414-415.

2903 Ghaiglom, D. 1990. **Outbreaks of forest insects and control operations in Thailand**. Proceedings of the IUFRO Workshop on Pests and Diseases of Forest Plantations in the Asia-Pacific Region, RFD Thailand F/FRED, FAO (RAPA), Bangkok: 219-223.

Chemical, biological and cultural control measures used against important insect pests of forest plantations including teak in Thailand are described. Biological control with a bacterial toxin of *Bacillus thuringiensis* Berliner was tested and proved to kill the larvae of both *H. puera*, and teak beehole borer, *X. ceramicus*.

2904 Ghorpade, B.R; Patil, S.P. 1991. **Insect pests recorded on forest trees in the Konkan region of Maharashtra State (India)**. Indian Journal of Forestry 14(3): 245-246.

The most important insect pests recorded on forest trees including teak are listed. *Eutectona grandis* was the most serious pest on teak.

2905 Ghude, D.B; Gogate, M.G. 1996. **Insect pests of teak in Maharashtra, India**. Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium, Peechi, 23-26 November 1993: 495-497. K.S.S. Nair; J.K. Sharma; R.V. Varma, Eds. Kerala Forest Research Institute, Peechi.

The major pests recorded from Maharashtra and the nature of damage caused by these are given. The pests are grouped into root and stem feeders, sap suckers, defoliators, tree borers, fruit borer and gall former.

2906 Gokulpure, R.S. 1969. **Record of tachinids from central India**. Indian Forester 95(3): 188-189.

Lists eight species, including *Hyblaea puera*, defoliator of teak.

2907 Gotoh, T. 1994. **Insect borers of some valuable timber species in Thailand**. Tropical Forestry 30: 30-37.

Descriptions include Xyleutes ceramicus and Dihammus cervinus damage to Tectona grandis.

2908 Gotoh, T; Kotulai, J.R; Matsumoto, K. 2004. **Stem borers of teak and yemane in Sabah, Malaysia with analysis of attacks by the teak beehole borer (*Xyleutes ceramica* Wlk)**. JARQ, Japan Agricultural Research Quarterly 37(4): 253-262.

2909 Gujar, D.R; Ghude, D.B; Gogate, M.G. 1996. **Incidence of a cerambycid girdler attack in teak seed orchard in Maharashtra, India**. Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium, Peechi, 23-26 November 1993: 498-501. K.S.S. Nair; J.K. Sharma; R.V. Varma, Eds. Kerala Forest Research Institute, Peechi.

Incidence of a cerambycid girdler attack on live teak trees in the teak seed orchard at Mohogata, District Bhandara of Maharashtra State is reported. Feeding by the grub resulted in girdling of the collar region. Severe infestations resulted in drying up and eventual death of the affected trees.

2910 Gupta, J.P. 1997 . **Histochemical investigations of leaf galls of *Tectona grandis* incited by an unknown midge from Sitamata forest-Rajasthan**. Journal of Phytological Research 10(1/2): 43-46.

Histochemical investigations were made on leaf galls of *Tectona grandis* caused by an unknown gall midge. The galls were discoid, covered with multicelled thick-walled acute trichomes and exhibited marked difference in the histology between gall and normal tissues.

2911 Harley, K.L.S. 1969. **The suitability of *Octotoma scabripennis* Guer. and *Uroplata girardi* Pic (Col., Chrysomelidae) for the control of Lantana (Verbenaceae) in Australia**. Bulletin of Entomological Research 58(4): 835-843.

Reviews the host range and biology of hispine beetles associated with lantana and related species, and reports studies of host specificity made in Hawaii with field populations of the introduced species *O. scabripennis* and *U. girardi*.

2912 Hauxwell, T.A. 1908. **A new species of beehole borer in teak**. Indian Forester 34(4): p216.

Identified as a species of *Aeolesthes*, a longicorn beetle and hence bee-holing and

boring of teak is attributed to other *Duomitus ceramicus*.

2913 Hedegart, T. 1968. **Investigation on insects working in teak flowers-1967**. Report of Teak Improvement Centre, Ngao, Lampang: 6p.

A description of insects caught and amount of pollen they carried is given.

2914 Hole, R.S. 1901. **Attacks of *Hyblaea puera* on teak trees**. Indian Forester 27(7): 349-355; 417-422.

2915 Hole, R.S. 1904. **Notes on *Hyblaea puera***. Indian Forester 30(1): 1-10.

2916 Hole, R.S. 1904. **Two notorious insect pests: teak insect pests: *Pyrausta machaeralis* and *Hyblaea puera***. Journal of the Bombay Natural History Society 15: 679-697.

2917 Hutacharern, C. 1992. **Research development of teak insect pests in Thailand**. Proceedings of the Seminar on 50 Anniversary of Hyay-Tak Teak plantation, Bangkok, 5-8 August 1992.

Teak insects have been under studies in Thailand since 1958. Due to very large areas of teak plantations being damaged, studies on teak defoliators were initiated and this led to the establishment of the Northern Forest Pest Control Center. These researches have included pheromone, mass rearing, population dynamics and behaviours, with the principal purpose of developing effective control measures. Emphasis has been given to the further study of teak defoliators, especially with regard to natural enemies.

2918 Hutacharern, C. 2000. **Management of important insect pests in teak plantations in Thailand**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 223-238. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

Discussed the pest problems of the teak plantations in Thailand. The pests are divided into two groups: stem borers and defoliators. The most important stem borers are the teak beehole borer, the red coffee borer and the teak canker grub. Control methods of the stem borers and defoliators are also discussed.

2919 Hutacharern, C. 2001. **Teak beehole borer, *Xyleutes ceramica*: Ecology and management**. Protection of World Forests from Insect Pests: Advances in Research. IUFRO World Series 2: 249-253. R. Alfaro; K. Day; S. Salom; K.S.S. Nair; H. Evans; A. Liebhold; F. Lieutier; M. Wagner; K. Futai; K. Suzuki, Eds. IUFRO Secretariat, Vienna.

2920 Hutson, J.L. 1932. **The red borer**. Tropical Agriculturist, Ceylon 79(3): 137-138.

Gives an account and life history of the red borer *Zeuzera coffeae*.

2921 Intachat, J. 1998. **The identity of a Malaysian teak skeletonizer, *Paliga damastesalis* Walker (Lepidoptera: Pyralidae)**. Journal of Tropical Forest Science 10(4): 561-563.

Specimens of teak skeletonizers from Malaysia have been identified as *Paliga damastesalis*, while in native teak growing countries they have been known as *Eutectona machaeralis*. The essential differences between the two species are briefly described, and a list is given of Asian *Paliga* species and their synonyms.

2922 Intachat, J. 1999. **The life history of *Paliga damastesalis* Walker (Lepidoptera: Pyraloidea: Crambidae), a teak skeletoniser in Malaysia**. Journal of Tropical Forest Science 11(4): 663-671.

The life history of *Paliga damastesalis* was studied under laboratory and field conditions.

2923 Intachat, J. 2000. **Insect pests in teak and sentang: Are they a serious problem?** Conference on forestry and forest products research 1997: Proceedings of the Fourth Conference, Malaysia, 2-4 October 1997: 229-235. S. Appanah; S.Y.M. Yusoff; A.W. Jasery; K.K. Choon, Eds. Forest Research Institute Malaysia, Kuala Lumpur.

This paper highlights the major insect pests found, their modes of attack, the symptoms, and the severity of their attacks. The major pests of teak are *Paliga damastesalis*, *Hyblaea puera* and *Xyleutes ceramica*. The severity of the attacks depends on the age of the plants that are attacked and insect abundance. Possible chemical and biological control measures for these major insect pests are discussed.

2924 Intari, S.E. 1975. **An observation on bee-hole borer (*Duomitus ceramicus* Wlk.) on teak plantations at Kendal and Ciamis Forest Districts**. Laporan, Lembaga Penelitian Hutan 204: 14p.

Notes are given on the bionomics, injuriousness and world distribution of *Xyleutes ceramicus*, the larvae of which bore in trunks of teak.

2925 Intari, S.E. 1984. **Effect of *Neotermes tectonae* attack on the quality and quantity of teak timber**. (Indonesian). Laporan, Pusat Penelitian dan Pengembangan Hutan, Indonesia 444/447: 1-13.

Losses of quality construction timber are reported as a result of the infestation of teak stands in Java by *N. tectonae*.

2926 Intari, S.E. 1990. **Effects of *Neotermes tectonae* Damm attack on the quality and quantity of teak timber in the Kebonharjo Forest Division, Central Java**. (Indonesian). Buletin Penelitian Hutan 530: 25-35. Pusat Penelitian dan Pengembangan Hutan, Bogor.

Volume reduction in quality of the timber from construction to fuelwood grade was 249.48 and 231.30 m3.

2927 Jacob, J.P. 1989. **Impact of age correlated biochemical changes of host plant on food consumption and utilization efficiency of *Aularches scabiosae* F. (Orthoptera: Insecta)**. Proceedings of the Indian Academy of Sciences, Animal Sciences 98(6): 391-397.

The relative preference and maximum utilization of mature leaves compared to young and senescent leaves were attributed to changes in the chemical profile, particularly in the protein, nitrogen, carbohydrate, phenol and free fatty acid contents.

2928 Jacob, J.P; Balu, A; Murugesan, S; Deeparaj, B; Srinivasan, G. 2002. **Variation in defoliator incidence on teak clones**. Proceedings of Vistas of Entomological Research for the New Millennium, 2002: 164-172.

2929 Joseph, K.J. 1982. **The reflex froth-discharging behaviour in the coffee locust (*Aularches miliaris* L.) as an anti-predator defensive mechanism**. Entomon 7(4): 407-409.

During mass infestation by the acridid *Aularches miliaris* (L.) of more than 1000 acres of plantations of different species which include teak, reflex discharge of a foul-smelling frothy liquid from the mesothoracic spiracles was observed. The frothy masses grew into large bubble-shaped structures that finally enveloped the body of the insect. The role of this behaviour as a defence mechanism against predation is discussed .

2930 Kadambi, K. 1951. **Teak defoliation**. Indian Forester 77(1): 64-70.

Early flushing often permits a tree to escape defoliation because its leaves are too tough for the larvae by the time they start feeding. Early flushing is due to an abundant supply of ground moisture, which suggests the possibility that defoliation could be controlled in irrigated plantations by standardizing the method and frequency of irrigation.

2931 Kalshoven, L.G.E. 1919. **The red teak borer**. (Dutch). Meded Proefsta Boschw 4: 57-68. Forest Research Station.

2932 Kalshoven, L.G.E. 1920. **Preliminary investigations of the harmful effects on living teak of *Xyleborus destruens***. Tectona 13: 32-57.

2933 Kalshoven, L.G.E. 1922. **Notes on forest zoology for the Netherlands East Indies 4. Insects and the land of origin of *Tectona grandis* Linn.f.)**. Tectona 15: 786-793.

Historical, etymological and phytogeographical and zoogeographical facts lead to the controversy - Is teak a native tree to Java? Zoogeographical evidence with respect to *Hyblaea puera*, *Zeuzera coffeae*, *Xyleborus destruens*, *Calotermes tectonae* and *Duomitus ceramica* is discussed and pointing out absence or presence of typical teak pests in Java suggested detailed investigation on origin of teak in Java.

2934 Kalshoven, L.G.E. 1922. **Notes on forest zoology for the Netherlands East Indies 5. A curious injury of tops of teak saplings by Coccids and small boring caterpillar, *Dunctiferalis***. Tectona 15: 944-950.

Teak sapling borer is identified as *Zeuzera coffeae*. Infestation by Coccids and damaged by lepidopterous larvae which caused small burrows in the terminal buds and in the thick bases of the main rib of young leaves.

2935 Kalshoven, L.G.E. 1932. ***Dichocrocis punctiferalis*-Pyralidae-as a fruit borer of teak**. (Dutch; English). Tectona 25: 1613-1620.

Caterpillars found in teak fruits are identified as *Dichocrocis punctiferalis*. Both felty mesocarp and non-stony endocarp are eaten by caterpillars. Pupation takes place within fruits and life history described, with alternate food plants.

2936 Kalshoven, L.G.E. 1934. **The teak leaf skeletonizer, *Pyrausta machaeralis* in Java**. (Dutch; English). Tectona 27: 71-75.

Pyrausta machaeralia var. *rubicundalis* Walk. is an important defoliator and the author suggests the teak is not the natural food plant. This divergence in food habits in Java and India is attributed to biological races of the moth or differences in the two countries in teak varieties.

2937 Kalshoven, L.G.E. 1939. **A longicorn borer in living and dead teak trees: *Monohammus rusticator* Fab., Fam. Lamiidae**. (Dutch). Tectona 32: 321-337.

This borer is considered of minor importance to the cultivation of teak in Java. The insect suffers from a high mortality in the larval stage, due mainly to an infectious disease, and the infestation of living bark occurs only where rain is plentiful.

2938 Kalshoven, L.G.E. 1940. **Observations on the red-branch borer *Zeuzera coffeae***. (Dutch; English). Ent. Meded Netherlands, India 6(3/4): 50-54. Agricultural University, Wageningen.

2939 Kalshoven, L.G.E. 1951. **Important outbreaks of insect pests in the forests of Indonesia**. Trans. 9th International Congress of Entomology, Amsterdam, 1951, 2: 229-234.

Discusses defoliation of teak forests and other cultivated forest trees in Java.

2940 Kalshoven, L.G.E. 1954. **Survival of Neotermes colonies in infested teak trunks after girdling or felling of the trees**. Tectona 43: 59-74.

Observations were made on the development of colonies of *Neotermes* inhabiting trunks of teak trees after girdling and also when felled and left lying on the forest floor. A few colonies may survive for as long as 10 months and it may be assumed that they produce large numbers of winged sexuals.

2941 Kalshoven, L.G.E. 1959. **Investigations of the initial infestation of new teak plantations by the trunk-inhabiting termite, *Neotermes tectonae* Damm in Java**. Entomologische Berichten, Amsterdam 19(7): 138-142.

Infestation was found at age of five and the first mature colony at age seven. At twelve, 30 percentage of all trees were infested.

2942 Kalshoven, L.G.E. 1959. **Observations on the nests of initial colonies of *Neotermes tectonae* Damm. in teak trees**. Insectes Sociaux, Paris 6(3): 231-242.

An account of observations in Java showing that new colonies of *N. tectonae* are started in dead branches in the crown.

2943 Kalshoven, L.G.E. 1960. **Biological notes on the *Cryptotermes* species of Indonesia**. Acta Tropica, Basel 17(3): 263-272.

Includes biology, habits, distribution, control etc. of the drywood termites *Cryptotermes domesticus, Cryptotermes dudleyi* and *Cryptotermes cynocephalus*.

2944 Kalshoven, L.G.E. 1961. **Observations on the ecology and epidemiology of *Xyleborus destruens* Bldf., the near primary borer in teak plantations in Java**. Bijdragen tot de Dierkunde, Amsterdam 31: 5-21.

It is suggested that teak should not be planted in areas stimulating very rapid growth, as such trees become very susceptible.

2945 Kalshoven, L.G.E. 1962. **Note on the habits of *Xyleborus destruens* Bldf., the near primary borer of teak trees in Java**. Entomologische Berichten, Amsterdam 22(1): 7-18.

Discussed outward signs of the borers' presence, their galleries, development and general biology, sex ratio, nutrition etc.

2946 Kalshoven, L.G.E. 1962. **Observations on *Coptotermes havilandi* Holmgr. (javanicus Kemn.) (Isoptera)**. Beaufortia, Amsterdam 9(101): 121-137.

Describes habits, nests, etc. mainly from observations in Javanese teak forests and gives a list of tree species attacked. Infested teak has been found.

2947 Kalshoven, L.G.E. 1963 . ***Coptotermes curvignathus* causing the death of trees in Indonesia and Malaya**. Entomologische Berichten, Amsterdam 23: 90-100.

Discusses its habitats and habits and the tree species attacked. Species including teak, appear to be susceptible.

2948 Katagal, R.D. 1996. **Incidence of defoliators in the teak plantation**. Insect Environment 2(1): p20.

A brief account is given of observations on the skeletonizer *Eutectona machaeralis* and the defoliator *Hyblaea puera* in a private teak plantation in Mahalingapur village, Bijapur district, Karnataka. Biological control possibilities are discussed.

2949 Katagal, R.D; Kumar, C.T.A; Kurdikeri, M.B. 2000. **Insect pests of teak around Bangalore**.

Karnataka Journal of Agricultural Sciences 13(1): 176-179.

A survey of insect pests attacking teak plantation was carried out in Karnataka. A total of 45 species were recorded from the teak plantations. Details are given of the five peak infestations and the insects involved.

2950 Katagal, R.D; Kumar, C.T.A; Kurdikeri, M.B. 2000. **Record of defoliator fauna in teak plantation**. Karnataka Journal of Agricultural Sciences 13(1): 180-183.

The intensity of infestation was recorded. Eighteen species of defoliators including a skeletoniser and leaf miner were recorded. The intensity of infestation was highest with *Myllocerus subfasciatus* var. *mutabilis* and *M. subfasciatus* var. spurcatus.

2951 Kedharnath, S; Singh, P. 1975. **Studies on natural variability in susceptibility of Tectona to leaf skeletonizer, *Pyrausta machaeralis***. Proceedings of the FAO/IUFRO Symposium on Forest Diseases and Insects, New Delhi.

2952 Kerala Forest Research Institute, Peechi. **The teak defoliation (Video film)**. (English; Malayalam). Kerala Forest Research Institute, Peechi.

A 20 minute scientific documentary on the teak defoliator, *Hyblaea puera*, the most dangerous forest plantation pest of the Asian tropics. Depicts the biology, pest population outbreaks and defoliation of the pest. Summarises the present knowledge on outbreak causation and suggests management methods.

2953 Khan, H.R; Bhandari, R.S; Lalji Prasad; Sushil Kumar. 1988. **Population dynamics of *Hyblaea puera* Cram. (Lepidoptera: Hyblaeidae) and *Eutectona machaeralis* Walk. (Lepidoptera: Pyralidae) in teak forest of Madhya Pradesh (India)**. Indian Forester 114(11): 803-813.

The seasonal abundance and population dynamics associated with incidence of attack were studied. The results are discussed in relation to pest status.

2954 Kietchaiyakorn, W. 1973. **Studies on the ecology of the bee-hole borer of teak (*Xyleutes caramicus* Walker)**. Special Problem of Study of Biology Department (Science), University of Thailand, Chaing-Mai 1973: 26p. Teak Improvement Centre, Ngao.

The biology of teak bee-hole borer *Xyleutes caramicus* walker was described. Older plantations are more susceptible. *Beauveria bassiana*, fungus used for biological control causes more mortality to the borer.

2955 Kossou, D.K. 1992. **The sensitivity of wood used for the construction of traditional granaries to attack by *Prostephanus truncatus* (Horn) (Coleoptera: Bostrichidae)**. Insect Science and its Application 13(3): 435-439.

Timber from 10 wood species widely used to construct granaries or cribs in Benin was tested for its susceptibility to *Prostephanus truncatus*. Timbers including *Tectona grandis* were the more susceptible species.

2956 Kumar, C.T.A; Katagal, R.D; Onkarappa, S. 2002. **Host preference of the teak defoliator, *Hyblaea puera* (Cramer) among the forest trees**. Myforest 38(3): 295-298.

A study was conducted to determine the effect of different host plants on the life cycle of the teak defoliator *Hyblaea puera*. The larva completed its development within 12 days on teak and the pupal period was found shortest in the larva reared on teak.

2957 Kyaw Sein, U. 1963. **The bee-hole borer of teak (*Xyleutes ceramica* Wlk.)**. Burmese Forester 13(2): 32-39.

A general account is given.

2958 Lakanavichian, S; Napompeth, B. 1990. **Ecological study of teak defoliators, *Hyblaea puera* and *Eutectona machaeralis* in Thailand**. Proceedings of the IUFRO Workshop on Pests and Diseases of Forest Plantations in the Asia-Pacific Region, RFD Thailand, F/FRED, FAO (RAPA), Bangkok: 155-166.

Altogether thirteen species of parasitic insects and three species of predators were found attacking these defoliators. Ecological studies on the teak defoliators, *Hyblaea puera* and *Eutectona machaeralis* were made under laboratory and field conditions.

2959 Lara, L.L. 1980. **Some common insect pests among the insect fauna of forests in Colombia. Aspects of their biology and control**. Sociedad Colombiana de Entomologia: Seminar on Forest Pests, Pereira, 27 November 1980: 117-132. Sociedad Colombiana de Entomologia; Bogota; Colombia.

Notes are given on the life-cycle and injuriousness and control of insect pests that attack forest trees in Colombia. Forest pests that included bagworms, *Oiketicus* sp. that attack teak.

2960 Lefroy, H.M. 1909. **A manual of the insects of plants (tropical India) 1. Lepidoptera**. Agricultural Research Institute, Pusa, New Delhi: 520p. Government of India Press, Calcutta.

Gives notes on the leaf skeletonising insects, *Hapalia machaeralis*, *Hyblaea puera* and *Cosus cadambae*.

2961 Lingappa, S; Hiremath, I.G; Deshpande, V.P. 1991. **A new threat to forest gold**. Myforest 27(1): 55-56.

Extensive occurrence of the teak stem borer, *Cossus cadambae* causing damage to stands in Karnataka is reported from a preliminary survey. Observations are presented on the biology of the pest and damage caused by it.

2962 Loganathan, J; David, P.M.M. 1999. **Rain fall: A major factor leading to outbreak of teak (*Tectona grandis*) defoliator, *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidae) in commercial teak plantation**. Indian Forester 125(3): 316-320.

Statistical analysis showed a significant positive relationship between defoliator incidence and rainfall, which therefore appeared to be the probable cause of the defoliator outbreak - delay in the rainfall lead to delay in defoliator infestation and vice-versa.

2963 Loganathan, J; David, P.M.M. 2000. **Impact of flood irrigation on defoliator attack in commercial teak plantation**. Madras Agricultural Journal 87(4/6): 328-329.

The effects of two irrigation systems, i.e. flood and drip irrigation, on the severity of defoliator attack was investigated. The severity of defoliator attack was high under both irrigation systems.

2964 Loganathan, J; Soman, P; Maragatham, S. 2001. **Monitoring of two major pests of teak in intensively managed plantation through light trap study**. Indian Forester 127(9): 1047-1052.

The population dynamics of teak defoliator and teak skeletonizer were studied in intensively managed teak plantation in Andhra Pradesh by installing light traps. A significant positive influence of rainfall and negative influence of wind velocity on defoliator is reported.

2965 Lopez-Castilla, R.A; Duarte-Casanova, A; Guerra-Rivero, C; Cruz-Escoto, H; Triguero-Issasi, N. 2002. **Forest nursery pest management in Cuba**. Western Forest and Conservation Nursery Association Conference, Kailua-Kona, Hawaii, 22-25 August 2000. Proceedings of Rocky Mountain Research Station, USDA Forest Service, 2002: 213-218. Rocky Mountain Research Station, Fort Collins.

A dozen insect species and three fungi species responsible for the major problems in forest nurseries in Cuba are studied. A defoliator of teak, *Draeculocephala cubana* is also reported.

2966 Mackenzie, J.M.D. 1941. **Some notes on forest insect pests in Burma**. Indian Forester 47(8): 309-317.

Attributes defoliation in teak to *Hyblaea puera* and *Pyrausta machaeralis* and comments on net increments loss, volume loss and financial loss in teak plantations of Burma due to insect attacks and defoliation. The damage caused by beehole borer *Duomitus ceramicus* is also discussed and remarks on life history and biological control of these insect pests is given.

2967 Mahobia, G.P; Pande, V.K; Sinha, B.R.R.P. 2002. **Frequency occurrence of Raily ecorace of *Antheraea mylitta* D. on different food plants in Bastar forest division in Chhattisgarh, India**. Bulletin of Indian Academy of Sericulture 6(2): 56-60.

The frequency of occurrence of natural cocoons of Raily ecorace of *A. mylitta* on different food plants including *Tectona grandis* in the forests of Bastar is studied.

2968 Mani, M.S. 1953. **On a collection of plant galls and gall midges from India**. Agra University, Journal of Research 2 (Part 2): p247.

Gives description of plant galls and gall midges of some Indian plants including teak.

2969 Mathew, G. 1986. **The teak carpenterworm, *Cossus cadambae* and its status as a pest in plantations**. Evergreen 17: 29-31.

An attempt is made to highlight the economic importance of a carpenterworm pest of teak in southern India viz., *Cossus cadambae*. Dealt with its life cycle, distribution, host range, seasonality and natural enemies.

2970 Mathew, G. 1987. ***Cossid* pests of plantation crops in India and the prospects of their management**. Proceedings of the Workshop on Insect Pest Management Strategies in Coffee, Tea and Cardamom Cropping Systems, Chikmangalore: 137-140.

The behaviour patterns and pest management of cossids in plantation crops in India were reviewed. Discussed various control measures which include the removal of infested trees for the control of *X. ceramica* in teak plantations and the use of pheromones for mass trapping.

2971 Mathew, G. 1990. **Biology and ecology of the teak trunk borer *Cossus cadambae* Moore and its possible control**. KFRI Research Report 68: 41p. Kerala Forest Research Institute, Trichur.

Studies were made on the biology, ecology and possible control of the teak trunk borer *Cossus cadambae*. The distribution of this insect in the various teak plantations in Kerala was studied. Plantations found affected were above 20 years old and the infestation intensity was found to increase with age. The progression of attack in plantations of varying levels of infestation intensity was studied.

2972 Mathew, G. 1990. **Cossid pests of teak in Asian region and the possibilities of their control**. Proceedings of the IUFRO Workshop on Pests and Diseases of Forest Plantations in the Asia-Pacific Region, RFD Thailand, F/Fred, FAO (RAPA), Bangkok: 204-208.

A combination of management strategies integrating silvicultural, pheromonal as well as biological control measures is required for controlling the infestation of cossid pests in teak plantations. Four species of carpenter worms viz. *Zeuzera coffeae*, *Z. roricyanea*, *Syleutes ceramicus* and *Cossus cadambae* attack teak in the Asian region; a review is made of their distribution, habits, biology and control.

2973 Mathew, G. 1991. **Biology, seasonal population trends and impact of the teak carpenterworm *Alcterogystia cadambae* (Moore) (Lepidoptera: Cossidae)**. Annals of Entomology 9(2): 39-46.

The biology and injuriousness of *Alcterogystia cadambae*, a pest of teak were investigated in the laboratory and field in Kerala. Larval feeding on the bark led to callus formation and secondary infection by microorganisms resulting in die-back of infested trees. Borer holes in affected timber caused depreciation in the commercial value of extracted wood.

2974 Mathew, G. 1997. **Distribution, infestation progression rate and host range of the teak carpenterworm, *Alcterogystia cadambae* Moore (Lepidoptera: Cossidae) in Kerala, India**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 86-92. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Studies on the distribution, host range, and progression of infestation of the teak borer, *Alcterogystia cadambae* Moore were made. Mechanical injury to trees such as lopping of branches, extraction of leaves, etc. promote establishment of this pest. Protection of trees from mechanical injury is suggested for regulating the build up of the pest in teak plantations.

2975 Mathew, G; Mohandas, K. 1989. **Insects associated with some forest trees in two types of natural forests in the Western Ghats, Kerala (India)**. Entomon 14(3/4): 325-333.

Insects occurring in moist deciduous and evergreen forests were surveyed in Kerala. Defoliation of species which include *Tectona grandis*.

2976 Mathew, G; Rugmini, P. 1996. **Impact of the borer *Alcterogystia cadambae* (Moore) (Lepidoptera: Cossidae) in forest plantations of teak in Kerala, India**. Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium, Peechi, 23-26 November 1993: 304-310. K.S.S. Nair; K.J. Sharma; R.V. Varma, Eds. Kerala Forest Research Institute, Peechi.

It causes extensive bark injury and riddling of the bole with numerous holes. The infested tree subsequently gets attacked by various pathogenic/saprophytic fungi which results in die-back as well as decay of wood.

2977 Mathew, G; Rugmini, P; Jayaraman, K. 1989. **Studies on spatial distribution in the teak carpenterworm, *Cossus cadambae* Moore (Lepidoptera, Cossidae)**. Journal of Research on the Lepidoptera 28(1/2): 88-96.

A considerable number of trees in a plantation were affected during the initial stages of infestation. In the subsequent phase, already infested trees tended to be reinfested, while healthy trees were also attacked.

2978 Mathew, G; Sudheendrakumar, V.V; Mohanadas, K; Nair, K.S.S. 1990. **An artificial**

diet for the teak defoliator, *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidea). Entomon 15(3/4): 159-163.

Synthetic diets containing teak leaf powder and *Cicer arietinum* flour were developed for rearing *Hyblaea puera*. The growth and development of 3- to 4-day-old larvae was compared on these diets and on teak leaves in the laboratory. Pupal weight and percentage survival were greater on the diet than on teak leaves.

2979 Mathur, R.N. 1956. **Immature stages of Indian Coleoptera (28): Anthribidae**. Indian Forest Records (n.s.) Entomology 9(5): 127-129.

The larval and pupal characters of *Autotropis modesta* are described with illustrations. It was found infesting a partly dead teak stump in the Andamans.

2980 Mathur, R.N. 1960. **Important problems in forest entomology of India**. Proceedings of 11th International Congress of Entomology, Vienna Vol. 2: 277-283.

Recent research on defoliators of teak is also reviewed with other problems of forest insects.

2981 Mathur, R.N. 1960. **Pests of teak and their control**. Indian Forest Records (n.s.) Entomology 10(3): 43-66.

Describes insect pests of living trees, felled trees and timber and classified according to the type of damage. The most important are *Hapalia machaeralis*, *Hyblaea puera*, *Dihammus cervinus, Sahyadrassus malabaricus* and *Xyleutes ceramica*. Control measures are discussed.

2982 Mathur, R.N. 1960. **Pests of teak and their control**. FAO Teak Sub-Commission, New Delhi, 1960, FAO/TSC-60/3.6: 25p.

Lists the pests by type of injury, with notes on life history, parasites and predators, etc.

2983 Mathur, R.N. 1964. **Forest entomological problems in India**. FAO/IUFRO Symposium on Internationally Dangerous Forest Diseases and Insects, Oxford.

Deals with teak defoliation caused by *Hapalia machaeralis* and *Hyblaea puera*.

2984 Mathur, R.N; Singh, B. 1960. **A list of insect pests of forest plants in India and the adjacent countries**. Indian Forest Bulletin (n.s.) 171(9), Entomology Series: 10-20.

Tectona grandis is one of the many species for which the insect pests have been listed.

2985 Mehrotra, M.D; Sharma, V. 1990. **Occurrence of root knot nematodes in forest nurseries**. Indian Forester 116(10): p846.

A preliminary report is given of the occurrence of root knot nematodes in forest nurseries in India including *Tectona grandis*.

2986 Mein, A.J. 1879. **Notes on the occurrence of teak borer beetle in Assam**. Indian Forester 4(9): 346-349.

2987 Mein, A.J. 1883. **Attacks of insects in the Kulsi teak plantations, Kamarup, Assam**. Indian Forester 9: p366.

Reports on swarms of *Hyblaea puera* eating and denuding leaves of older trees, and pupating in long grass below, but no damage to trees.

2988 Menon, K.D. 1952. **Cossid moth attack on young plantation trees**. Malaysian Forester 15(4): 208-209.

This moth has been attacking plantations at Kepong, attacking young trees of species including *Tectona grandis*.

2989 Menon, K.D. 1963. **Defoliation of teak in north-west Malaya**. Malaysian Forester 26(3): 209-210.

A note on the defoliation of a plantation in Perlis by an outbreak of yellow butterflies.

2990 Meshram, P.B; Pathak, S.C; Jamaluddin. 1990. **Population dynamics and seasonal abundance of some forest insect pests (nursery stage) through light trap**. Indian Forester 116(6): 494-503.

Trapped insects include the teak defoliator, *Hyblaea puera*; the teak skeletonizer, *Eutectona machaeralis*; the white root grub, *Holotrichia serrata*.

2991 Meshram, P.B; Patra, A.K. 2003. **Heavy outbreak of parakeet *Psittacula krameri* (Scopoli) in Hi-Tech teak plantations at Chhindwara**. Indian Forester 129(3): 413-414.

A severe infestation of *Psittacula krameri* in teak plantations in Chhindwara, Madhya Pradesh is reported for the first time. Control measures are suggested.

2992 Mieke, S. 1994. **Some pests and diseases of forest timber estate in Indonesia**. JIRCAS

International Symposium Series, Japan, March 1994, No. 1: 158-162.

A list of the forest pests and diseases attacking fruits/seeds, leaves, stems and the root system is presented in this report.

2993 Mishra, G.P; Joseph, R.N. 1982. **Defoliation in teak by lepidopterous defoliators in a mixed dry deciduous forest of Sagar, Madhya Pradesh**. Indian Forester 108(8): 372-373.

Data are tabulated on defoliation on plateau, slope and base areas.

2994 Mishra, S.C. 1992. **Digestion of major food (leaf) components by the teak defoliating lepidopterous larvae *Hyblaea puera* Cram. (Hyblaeidae) and *Eutectona machaeralis* Walk. (Pyralidae)**. Indian Forester 118(11): 848-855.

Hyblaea puera and *Eutectona machaeralis* are both serious pests of teak in India, particularly when they occur together. The larvae of *E. machaeralis* feed on the older leaf tissues between the veins while those of *H. puera* feed on the tender leaves. Leaf contents and digestion of each chemical component are discussed and the probable mechanism of degradation of polysaccharides and lignins indicated.

2995 Mishra, S.C; Sen Sarma, P.K. 1986. **Host specificity test and a note on life history of *Leptobyrsa decora* Drake (Hemiptera: Tingidae) on teak**. Bulletin of Entomology, New Delhi 27(2): 81-86.

Studies on the host-specificity of the tingid *Leptobyrsa decora* and observations on its life history on the weed *Lantana camara* and on *Tectona grandis* were carried out in an insectary. The adults were able to survive on *T. grandis*, but could not survive for longer periods on *T. grandis* than they did on *L. camara* due to the thickness of teak leaves. The life history of the insect and its potential for the control of the weed are discussed.

2996 Misra, M.P. 1975. **Sexing of pupae and adult moths of teak skeletonizer, *Pyrausta machaeralis* Walker (Lepidoptera: Pyralidae)**. Indian Forester 101(5): 301-304.

The secondary sexual characters of pupae and adults of *Pyrausta machaeralis*, a pest of teak in India are described.

2997 Mohammad Yousuf; Joshi, K.C. 2003. **Description of a new species of *Oligosita* Haliday (Hymenoptera: Trichogrammatidae) from India**. Shashpa 10(1): 7-8.

2998 Mohanadas, K. 1986. **A new host record for the teak defoliator, *Hyblaea puera* (Lepidoptera: Hyblaeidae)**. Current Science 55(23): 1207-1208.

Vitex altissima was recorded for the first time as a host plant of *Hyblaea puera*, a pest of teak in Kerala.

2999 Mohanadas, K. 1997. **Population trend of *Hyblaea puera* Cramer (Lepidoptera, Hyblaeidae) in teak plantations and the factors influencing it**. Ph.D Thesis. Cochin University of Science and Technology, Kerala.

3000 Mohanadas, K; Mathew, G; Gopinath, A. 2000. **Incidence of the cotton aphid, *Aphis gossypii* Glover (Homoptera: Aphididae) on teak inflorescence in Kerala**. Annals of Forestry 8(2): 289-290.

3001 Mohanasundaram, M. 1981. **Five new species of *Anthocoptes* Nalepa (1892) (Eriophyidae: Acarina) from South India**. Entomon 6(4): 343-350.

Five new species of eriophyid mite of the genus *Anthocoptes* from southern India are described of which *A. tectonae* collected from teak.

3002 Mohanasundaram, M. 1981. **Record of Rhyncaphytoptid gall mites (Rhyncaphytoptidae: Eriophyoidea) from south India**. Oriental Insects 15(1): 45-55.

Notes are given on eight species of rhyncaphytoptid mites collected in southern India, of which *Diptilomiopus jevremovici* Keifer was collected from various plants and trees including teak.

3003 Murali, K.S; Sukumar, R. 1993. **Leaf flushing phenology and herbivory in a tropical dry deciduous forest, southern India**. Oecologia 94(1): 114-119.

Patterns of leaf flushing phenology of trees in relation to insect herbivore damage were studied at a tropical dry deciduous forest site and a tropical dry thorn forest site in Mudumalai, Tamil Nadu. The most common tree species at the deciduous forest site include teak. The observations indicate that herbivory may have a significant role in evolution of leaf flushing phenology in trees from the seasonal tropics.

3004 Murugan, K; Kumar, N.S. 1996. **Host plant biochemical diversity, feeding, growth and reproduction of teak defoliator *Hyblaea pu-***

***era* (Cramer) (Lepidoptera: Hyblaeidae)**. Indian Journal of Forestry 19(3): 253-257.

Food consumption, utilization and reproduction of the teak defoliator, *Hyblaea puera*, showed age specific preferences amongst young, mature and senescent host leaves in laboratory experiments. The amount of leaves consumed, total egg output and adult longevity were maximum in *H. puera* reared on young leaves.

3005 Nair, K.S.S. 1982. **Seasonal incidence, host range and control of the teak sapling borer, *Sahyadrassus malabaricus***. KFRI Research Report 16: 36p. Kerala Forest Research Institute, Peechi.

The incidence of infestation of *S. malabaricus* in plantations of teak, eucalypts and other species is described and given an account of its life history, ecology and control methods. The most important forest trees attacked include saplings of teak.

3006 Nair, K.S.S. 1987. **Migration, a mechanism of parasite evasion**. Advances in Biological Control Research in India. Proceedings of the National Seminar on Entomology, Calicut, Kerala: 84-86.

Migration is a strategy used by some insects to escape parasitism. The teak defoliator, *Hyblaea puera*, in which, moths newly emerging from an epidemic area migrate to another area for egg laying, leaving behind the parasitoid population built up during their generation.

3007 Nair, K.S.S. 1987. **Life history, ecology and pest status of the sapling borer, *Sahyadrassus malabaricus* (Lepidoptera, Hepialidae)**. Entomon 12(2): 167-173.

The biology of *Sahyadrassus malabaricus* on teak and *Trema orientalis* was studied in the field in Kerala.

3008 Nair, K.S.S. 1988. **The teak defoliator in Kerala, India**. Population Dynamics of Forest Insects: 267-289. A.A. Berryman, Ed. Plenum Press, New York.

Two species of insects are well-known pests of the teak tree in India - *Hyblaea puera* and *Eutectona machaeralis*. One of the most promising approaches to its management appears to be the attempt to break the synchrony between flushing of teak and spring arrival of moths, by breeding early flushing varieties of teak.

3009 Nair, K.S.S. 1991. **Social, economic and policy aspects of integrated pest management of forest defoliators in India**. Proceedings of a Symposium, Towards integrated pest management of forest defoliators, 18th International Congress of Entomology, Vancouver, Canada, 1988. Forest Ecology and Management 39(1/4): 283-288.

Factors which have hindered successful development and adoption of integrated pest management strategies against forest defoliators are summarized.

3010 Nair, K.S.S. 2000. **Insect pests and diseases in Indonesian forests: An assessment of the major threats, research efforts and literature: 91p**. Center for International Forestry Research, Jakarta, Indonesia.

Major pests and diseases of natural and planted Indonesian forests have been reviewed, threats assessed and a bibliography compiled. Major plantation species include *Tectona grandis*.

3011 Nair, K.S.S. 2003. **Pest factor in the intensification of teak cultivation - a global assessment**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Pest problems arising from intensive plantation management are not judged to be serious, but expansion of exotic plantations could lead to serious outbreaks of the defoliator, *Hyblaea puera*, which is a well-known pest of native teak plantations in Asia. Research is needed to elucidate the conditions which lead to development of outbreaks of this serious pest.

3012 Nair, K.S.S; Mathew, G; Mohanadas, K; Menon, A.R.R. 1986. **A study of insect pest incidence in natural forests**. KFRI Research Report 44: 28p. Kerala Forest Research Institute, Peechi.

Insect damage was studied in representative natural forests in Kerala. Observations were made on twenty tree species in moist deciduous forest and eighteen in evergreen forest. A total of 85 insects was found on the 20 species studied in the moist deciduous forest. A total of eight insects was found on the 18 species studied in the evergreen forest. These insects are listed, with notes of the host, damage noticed, and previous records of insects on that host.

3013 Nair, K.S.S; Mohanadas, K; Sudheendrakumar, V.V. 1994. **Development of a management strategy for the teak defoliator, *Hyblaea puera***. KFRI Research Report 95: 125p. Kerala Forest Research Institute, Peechi.

The population dynamics of *Hyblaea puera* was investigated over a three year period by sampling immature stages of the pest. The noticeable event in the widespread outbreak of the caterpillar was the sudden occurrence of high density infestation at tree tops. Evidences indicate that *H. puera* population outbreak is of the eruptive types. The practical implications of the results for management of the teak defoliator and the future efforts needed are discussed briefly.

3014 Nair, K.S.S; Mohanadas, K. 1996. **Early events in the outbreak of the teak caterpillar, *Hyblaea puera***. International Journal of Ecology and Environmental Sciences 22: 271-279.

The first noticeable event in the chain of events leading to widespread outbreak of *Hyblaea puera* is the sudden occurrence of fairly high density, tree top infestations in small, discrete patches. The evidence indicate that *H. puera* population outbreak is of the eruptive type.

3015 Nair, K.S.S; Sudheendrakumar, V.V; Varma, R.V; Chacko, K.C. 1985. **Studies on the seasonal incidence of defoliators and the effect of defoliation on volume increment of teak**. KFRI Research Report 30: 78p. Kerala Forest Research Institute, Peechi.

The seasonal incidence of defoliation and its effect on the growth of teak were studied in plantations in Kerala. A model of the population dynamics of *H. puera* is proposed. The most serious impact of defoliation was loss of volume increment.

3016 Nair, K.S.S; Sudheendrakumar, V.V. 1986. **Population dynamics of teak defoliators**. Proceedings of the 18th IUFRO World Congress Division 2, Ljubljana, Yugoslavia, 8-12 September 1986. Vol.2; 673-684.

The biology and seasonal population fluctuations of the principal defoliators of teak in tropical India are examined. The mechanisms by which epidemics of *H. puera* may profoundly influence the population dynamics of *Eutectona machaeralis* is described and the importance of interactions among the pests stressed.

3017 Nair, K.S.S; Sudheendrakumar, V.V. 1986. **The teak defoliator, *Hyblaea puera*: Defoliation dynamics and evidences for short-range migration of moths**. Proceedings of the Indian Academy of Sciences, Animal Science 95(1): 7-21.

In teak plantations at Nilambur, Kerala, *Hyblaea puera* caused one or two waves of epidemic defoliation between late April and July. The temporal and spatial distribution of infestation and certain behavioural characteristics of population gave evidence of short-range migration of newly emerged moths. In a model proposed for population dynamics of *H. puera*, no diapause occurs and a residual, non-migratory population exists in natural forests during the non-epidemic period.

3018 Nair, K.S.S; Sudheendrakumar, V.V; Varma, R.V; Chacko, K.C; Jayaraman, K. 1996. **Effect of defoliation by *Hyblaea puera* and *Eutectona machaeralis* (Lepidoptera) on volume increment of teak**. Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium, Peechi, 23-26 November 1993: 257-273. K.S.S. Nair; J.K. Sharma; R.V. Varma, Eds. Kerala Forest Research Institute, Peechi.

The impact of defoliation on plantation grown teak was studied at Nilambur in Kerala. *E. machaeralis* which feeds on older leaves towards the end of the growth season had no significant impact on tree growth. *H. puera* which caused 1 to 3 total or near-total defoliations per year during the early part of the growth season caused very significant loss of increment. It is suggested that in theory, protected plantations can yield the same volume of wood in 26 years as unprotected plantations would yield in 60 years, provided other necessary inputs are given.

3019 Nair, K.S.S; Sudheendrakumar, V.V; Varma, R.V; Mohanadas, K. 1998. **Tracing the epicentres of teak defoliator outbreaks in Kerala**. KFRI Research Report 147: 27p. Kerala Forest Research Institute, Peechi.

It appears that many of the large-scale outbreaks can be prevented by controlling the small epicentre populations. An experimental study involving control of epicentre populations is recommended to examine the effectiveness of this approach to teak defoliator management. The study also revealed that teak plantations in all areas are not equally prone to defoliator attack - incidence of outbreaks appears to be strongly correlated with the mountain features of the planted area.

3020 Nair, K.S.S; Varma, R.V; Mathew, G; Sudheendrakumar, V.V; Mohanadas, K. 1996. **Perceived impact of insect pest problems in forest plantations in Kerala**. Impact of Diseases and Insect Pests in Tropical Forests. Proceedings of the IUFRO Symposium, Peechi, 23-26 November 1993: 317-323. K.S.S. Nair, et al, Eds. Kerala Forest Research Institute, Peechi and FORSPA, Bangkok.

An assessment of the insect pest problems in forest plantations in Kerala is made. This gives a reflection of the importance of pest problems are perceived by the resource managers. The perceived impact is then compared with the real impact as judged from the available scientific data. The study showed that the perceived impact matched with the real impact only in some cases.

3021 Nakamura, K; Nakashima, T; Ikeda, T; Eungwijarnpanya, S; Yincharoen, S; Hutacharern, C. 2002 . **Sex pheromone of the teak beehole borer, *Xyleutes ceramicus***. Proceedings of the IUFRO FAO Workshop on Pest Management in Tropical Forest Plantations, Chanthaburi, Thailand, 25-29 May 1998. C. Hutacharen; B. Napompeth; G. Allard; F.R. Wylie, Eds. FORSPA-Publication 30: 93-98. FAO Regional Office for Asia and the Pacific, Bangkok.

To identify the sex pheromone of *Xyleutes ceramicus*, conducted extraction from female moths, separation of crude extracts into fractions on Sep-pak silica cartridge, $AgNO_3$-silica gel column chromatography and gas chromatography. Obtained active fraction eliciting strong male responses for further analyses of chemical structure of sex pheromone which are suggested to be acetate group.

3022 Nansen, C; Meikle, W.G. 2003. **Use of pheromone-baited trap catches as indicators of occurrence of potential hosts of *Prostephanus truncatus* (Horn) (Coleoptera: Bostrichidae) in a forest in southern Benin**. Advances in stored product protection. Proceedings of the 8th International Working Conference on Stored Product Protection, York, UK, 22-26 July 2002. P.F. Credland; D.M. Armitage; C.H. Bell; P.M. Cogan; E. Highley, Eds: 71-77. CABI Publishing, Wallingford, UK.

The traps were established inside the forest, in a teak plantation surrounding the forest and at four sites approximately 50 m from smallholders' maize stores. Pheromone trap catches were highest in teak-dominated vegetation. In subsequent rearing experiments in the laboratory, the reproductive rate of *P. truncatus* on teak branches, roots and seeds was studied.

3023 Natawiria, D; Tarumingkeng, R.C. 1971. **Some important pests of forest trees in Indonesia**. Rimba Indonesia 16(3/4): 151-165.

Reviews the biology, economic importance and control of *Neotermes tectonae*, the borer *Xyleborus destruens*and the teak leaf skeletonizer *Pyrausta machaeralis* all on *Tectona grandis* and the borer *Xystrocera festiva*. Severe outbreaks of *P. machaeralis* have been reported in the main teak-growing areas of Java. Some parasites and predators are listed.

3024 Nayak, B.G; Hanumantha, M; Ganigera, B.S; Patil, S.K. 2002. **Infestation status of teak leaf skeletonizer, *Eutectona machaeralis* Walk. (Lepidoptera: Pyralidae) in different locations of Uttara Kannada District**. My-forest 38(4): 373-377.

A survey was conducted in selected teak plantations in Karnataka. Results showed that leaf skeletonizer infestation was more severe and causes more damages in plantations in Sirsi taluk and Honnavar taluk plantations compared to remaining taluks.

3025 Patil, B.V; Thontadarya, T.S. 1981. **Record of *Beauveria bassiana* (Balsamo) Vuillemin on teak skeletonizer, *Pyrausta machaeralis* (Walker)**. Indian Forester 107(11): 698-699.

Eutectona machaeralis skeletonises the leaves of teak. Of 180 larvae collected in teak plantations in Karnataka, 52 were found to be infected with *Beauveria bassiana*. Healthy 3rd-, 4th- or 5th-instar larvae artificially infected with this fungus in the laboratory died within 2 days.

3026 Patil, B.V; Thontadarya, T.S. 1983. **Seasonal incidence of teak skeletonizer *Pyrausta machaeralis* Walker (Lepidoptera: Pyralidae) in Prabhunagar Forest**. Indian Journal of Ecology 10(2): 204-209.

In Prabhunagar Forest, Karnataka, peak larval populations of *Pyrausta machaeralis* on teak occurred with increased adult populations in the last week of September.

3027 Patil, B.V; Thontadarya, T.S. 1987. **Biology of the teak skeletonizer, *Pyrausta machaeralis* Walker (Lepidoptera: Pyralidae)**. Mysore Journal of Agricultural Sciences 21(1): 32-39.

The biology of *Pyrausta machaeralis* was studied in the laboratory and field on teak in Karnataka.

3028 Patil, B.V; Thontadarya, T.S. 1987. **Correlation studies of the teak skeletonizer, *Pyrausta machaeralis* Walker with some biotic and abiotic factors**. Mysore Journal of Agricultural Sciences 21(2): 177-183.

The population dynamics of the pyralid *Pyrausta machaeralis* were studied in Karnataka. Populations of parasitoids and climatic factors, such as rainfall, relative humidity and maximum and minimum temperatures were significantly correlated with the different age intervals of the pest.

3029 Patil, B.V; Thontadarya, T.S. 1987. **Studies on the induction and termination of hibernation of the teak skeletonizer *Eutectona machaeralis* Walker (Lepidoptera: Pyralidae)**. Entomon 12(3): 179-182.

The factors responsible for the induction and termination of diapause in the teak pest *Eutectona machaeralis* were investigated in the laboratory. It is reported that termination of hibernation occurs when hibernating larvae are exposed to high temperatures and high relative humidities.

3030 Patil, S.U; Naik, M.I. 1996. **Cumulative effect of rearing *Trichogramma chilonis* Ishii on teak defoliator, *Hyblaea puera* Cramer and a laboratory host *Corcyra cephalonica* Stainton**. Indian Journal of Forestry 19(4): 368-370.

Parasitization by *T. chilonis* was slightly more on *H. puera* than on *C. cephalonica*, indicating the higher preference for *H. puera* eggs by *T. chilonis*.

3031 Patil, S.U; Naik, M.I. 1997. **Ovipositional trend and larval population pattern of teak defoliator, *Hyblaea puera* Cramer, at different heights of teak (*Tectona grandis* Linn.f.) trees**. Indian Journal of Forestry 20(2): 150-152.

Initially egg and larval populations were high in the top portion of the trees, but subsequently increased in the middle and the lower portions, because of defoliation at the top. Among the three tree heights high parasitization by *Trichogramma chilonis* was observed in bottom throughout the period of investigation.

3032 Pawar, C.S; Bhatnagar, V.S. 1989. **Seasonal activity of the teak defoliator *Hyblaea puera* Cramer (Lepidoptera: Hyblacidae) at ICRISAT, Patancheru, Andhra Pradesh**. Current Science 58(9): p521.

Field studies were conducted at ICRISAT in Andhra Pradesh to determine the activity of *H. puera* using light traps. The peak activity period was August-September. The origin of *H. puera* adults collected in the traps was not known.

3033 Pawar, C.S; Bhatnagar, V.S. 1990. **Seasonal activity of the teak defoliator *Hyblaea puera* Cramer (Lepidoptera: Hyblacidae) at ICRISAT Center, Patancheru, Andhra Pradesh**. Indian Journal of Forestry 13(2): 172-173.

Data are presented from monthly light trap catches of *Hyblaea puera*. The insect is a serious pest of teak and passes through 14 generations a year. Peak activity was recorded in July-October.

3034 Pearce, K.G; Hanapi, S. 1984. ***Acherontia lachesis* - a new pest of teak (*Tectona grandis*) in Malaysia**. Malaysian Forester 47(1/2): 80-81.

Larvae of *Acherontia lachesis* were found rapidly defoliating teak seedlings in Sarawak. They were preferring the larger, thicker mature leaves and also appearing to be attracted by leaf hairiness.

3035 Peres Filho, O; Dorval, A; Berti Filho, E. 2002. **Occurrence of the teak defoliator *Hyblaea puera* (Cramer, 1777) (Lepidoptera: Hyblaeidae) in teak (*Tectona grandis* Linn.f.) in Brazil**. Bragantia 61(1): 59-60.

Reported the occurrence of the *H. puera* in plantations of teak in Brazil.

3036 Prakasan, C.B; Kumar, P.K.V; Reddy, A.G.S. 1992. **Stink bug aggregation on vegetation in Waynaad**. Journal of Coffee Research 22(2): 135-138.

An aggregation of *Udonga montana* was noticed on vegetation in the Waynaad District of Kerala. The pentatomid was also found on forest trees including teak.

3037 Prasad, R; Meshram, P.B; Jamaluddin. 1990. **Possibilities for enhancing the fruiting in teak seed orchards**. Indian Forester 116(2): 99-102.

In teak seed orchards, insects such as fruit borer/inflorescence feeder and sap sucker were found to cause extensive damage. Besides these insects teak defoliator, *Hyblaea puera* and skeletoniser, *Eutectona machaeralis* also reduce the vigour of plants.

3038 Premrasme, T; Smitinand, T; Ghaiglom, D. 1963. **Research on the destruction by and protection from attack of the teak bee-hole borer (*Xyleutes ceramicus* walker)**. (Thai). Royal Forest Department, Bangkok, Research Report: 20p. Teak Improvement Centre, Ngao.

3039 Premrasme, T; Smitinand, T; Sahibuli, T; Ghaiglom, D. 1966. **Studies on the biology, ecology and control of teak bee-hole borer *Xyleutes ceramicus*-walker in the Northern plantation teak forest**. Royal Forest Department, Bangkok, Research Report: 19p.

3040 Rajak, R.C; Agarwal, G.P; Khan, A.R; Sandhu, S.S. 1993. **Susceptibility of teak defoliator (*Hyblaea puera* Cramer) and teak skeletonizer (*Eutectona machaeralis* Walker) to *Beauveria bassiana* (Bals.) Vuill**. Indian Journal of Experimental Biology 31(1): 80-82.

Laboratory studies showed that susceptibility of *Hyblaea puera* and *Eutectona machaeralis*, both pests of *Tectona grandis*, to *Beauveria bassiana* was influenced by larval age. Infectivity decreased with an increase in larval age.

3041 Rajak, R.C; Sandhu, S.S; Khan, A.R; Agarwal, G.P. 1990. **Susceptibility of teak defoliator and teak skeletonizer (Lepidoptera: Noctuidae) to *Beauveria bassiana*: Effects of instar, dosage and temperature**. Proceedings and abstracts. Vth International Colloquium on Invertebrate Pathology and Microbial Control, Adelaide, Australia, 20-24 August 1990: p153. Department of Entomology, University of Adelaide, Glen Osmond, Australia.

The susceptibility of larvae of *Hyblaea puera* and *Eutectona machaeralis* to *Beauveria bassiana* was studied. Mortality decreased with increase in age of larvae. Maximum mortality was recorded in 2nd-instar larvae of *H. puera* and *E. machaeralis*.

3042 Raman, S; Das, S.N. 1980. **Population density of plant-parasitic nematodes associated with some forest trees in Orissa**. Indian Forester 106(9): 621-624.

Nematode genera present in the root zone and their density are tabulated for 28 species. Maximum numbers were on *Tectona grandis*.

3043 Rane, N; Ghate, H. 1997. **The buprestid, *Psiloptera fastuosa* Fabr**. Insect Environment 3(2): p29.

Psiloptera fastuosa was reported to be a pest of teak.

3044 Rappard, F.W. 1950. **Aphids on teak**. (Dutch). Tectona 40(2): 160-162.

Damage is very slight, but severe infestation of the underside of half-grown leaves will cause them to shrivel.

3045 Rappard, F.W. 1950. **The snail *Achatina fulica*, a danger to young teak plantations**. (Dutch). Tectona 40(3/4): 365-366.

Infestation destroyed 90 percent of 1st-year nursery seedlings both leading shoots and side leaves being eaten.

3046 Rativanichi, T; Weissmann, G. 1973. **Chemical constitutions of teak (*Tectona grandis*) and their influence on the attack of the beehole borer (*Xyleutes ceramicus*)**. Natural History Bulletin of the Siam Society 24(3/4).

Samples of teak wood which were attacked or not attacked by the teak beehole borer were investigated. *Beauveria bassiana* has been tested and is found effective when the larvae have developed to maturity.

3047 Remadevi, O.K; Muthukrishnan, R; Srinivasa, Y.B. 2003. **Clonal variation in the incidence of phytophagous insects - some thoughts on divergence of teak**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

The population divergence of teak across the state of Karnataka, with respect to the incidence of phytophagous insects is studied. Variation in the incidence of *A. dispersus* was detected across individual clones indicating divergence in the populations of teak.

3048 Remadevi, O.K; Sivaramakrishnan, V.R. 1996. **Biomass utilisation by *Diacrisia obliqua* Walker feeding on *Tectona grandis* Linn.f. and *Parthenium hysterophorus* L**. Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium, Peechi, 23-26 November 1993: 441-447. K.S.S. Nair; J.K. Sharma; R.V. Varma, Eds. Kerala Forest Research Institute, Peechi.

The polyphagous arctiid pest *Diacrisia obliqua* feeds on the leaves of both teak tree and the weed, *Parthenium hysterophorus*. The nutritional indices on both the plants were studied simultaneously and compared. It is shown that *Parthenium* is nutritionally more suitable for the growth and survival of *S. obliqua*, although leaf consumption was higher for teak.

3049 Roonwal, M.L. 1954. **Biology and ecology of oriental termites (Isoptera). No. 1: *Odontotermes parvidens* Holmg. and Holmg. severly damaging the bark and contributing to the death of standing teak trees in Uttar Pradesh, India. No. 2: On ecological adjustment in nature between two species of termite, *Coptotermes heimi* (Wasm.) and *Odontotermes redemanni* (Wasm.) in Madhya Pradesh, India**. Journal of the Bombay Natural History Society 52(2/3): 459-467.

The termite *O. parvidens* destroyed the bark and killing the cambium, and causing a girdling effect.

3050 Roychoudhury, N. 1999. **Spinning behaviour and pupal-web formation in teak leaf skeletonizer, *Eutectona machaeralis***. Indian Journal of Entomology 61(3): 296-298.

3051 Roychoudhury, N. 1999. **Teak defoliator and host plants: An ecological relationship**. Advances in Forestry Research in India 20: 182-189.

An update of the alternative host plants of the teak defoliator, *Hyblaea puera* is presented.

3052 Roychoudhury, N; Jain, A; Joshi, K.C. 1995. **Alteration of growth and development in leaf skeletonizer *Eutectona machaeralis* Walker, due to variations in teak leaves of different maturity**. Indian Journal of Experimental Biology 33(3): 227-229.

Measurements were made of the differences among teak leaves of different degrees of maturity for growth and development of *Eutectona machaeralis*. Tender leaves contained relatively high percentages of water, nitrogen and polyphenol contents and there was a rapid decline in intermediate and mature leaves.

3053 Roychoudhury, N; Joshi, K.C. 1995. **Larval feeding habits and moulting behaviour of *Hyblaea puera* Cramer on teak**. Advances in Forestry Research in India 12: 228-233.

A review of studies in India on the pest of teak.

3054 Roychoudhury, N; Joshi, K.C; Pal, R. 1997. **Larval feeding preference of leaf skeletonizer *Eutectona machaeralis* walker, on teak leaves of different levels of maturity**. Advances in Forestry Research in India 16: 172-179.

Measurements were made of the larval feeding preference of *Eutectona machaeralis* for teak leaves of different maturity through bioassays in the laboratory. Leaf consumption by area was found to be significantly more on tender leaves, followed by intermediate and mature leaves.

3055 Roychoudhury, N; Joshi, K.C. 1997. **Larval feeding habits and moulting behaviour of leaf skeletonizer, *Eutectona machaeralis* Walker, on teak**. Indian Forester 123(5): 438-439.

A brief descriptive account is given.

3056 Roychoudhury, N; Joshi, K.C. 2000. **Natural resistance in teak to *Spodoptera litura* (Fabricius) Boursin (Lepidoptera: Noctuidae)**. Indian Forester 126(7): 792-796.

Nine selected plus tree progenies of teak from Orissa, Andhra Pradesh, Tamil Nadu and Maharashtra were evaluated for their natural variation in resistance to *Spodoptera litura*, a major pest of teak at the nursery stage in Madhya Pradesh. Plus tree progeny of one from Orissa and another from Andhra Pradesh were the most resistance and most susceptible.

3057 Roychoudhury, N; Kalia, S; Joshi, K.C. 1995. **Pest status and larval feeding preference of *Spodoptera litura* (Fabricius) Boursin (Lepidoptera: Noctuidae) on teak**. Indian Forester 121(6): 581-583.

Surveys were carried out of insect pests damaging teak at the nursery stage at Jabalpur, Madhya Pradesh. Serious damage was observed from attack by *Spodoptera litura*. Brief details are given of the life cycle of the pest on teak seedlings.

3058 Rutherford. 1913. ***Zeuzera coffeae* Nieta (Red borers)**. Tropical Agriculturist, Ceylon 41(6): 486-488.

3059 Sajeev, T.V. 1999. **Spatial dynamics of teak defoliator (*Hyblaea puera* Cramer) outbreaks: Patterns and causes**. Ph.D Thesis. Cochin University of Science and Technology.

It is found that the outbreaks of the species originate by the population build up in small epicentres from where it spreads to larger areas over successive generations.

3060 Sands, W.A. 1960. **Observations on termites destructive to trees and crops**. Colonial Termite Research, Commonwealth Institute of Entomology, London 1956-60: 14-66.

Damage caused to teak by *Amitermes evuncifer, Microcerotermes* sp. and *Microtermes* sp. are reported.

3061 Santhakumaran, L.N. 1985. **Marine wood borers of India, an annotated bibliography**. Wood Preservation Centre (Marine), National Institute of Oceanography, Dona Paula, Goa: 147p.

3062 Santhakumaran, L.N. 1988. **Marine wood borers of India, an annotated bibliography**. Wood Preservation Centre (Marine), National Institute of Oceanography, Dona Paula, Goa: 56p.

3063 Santhosh, K; Kumar, P. 2002. **Studies on infestation status of teak trunk borer *Alcterogystia cadambae* Moore (Lepidoptera: Cossidae) in clonal seed orchards of Karnataka**. Myforest 38(4): 365-371.

Influence of locality on trunk borer incidence was significant which could be due to a difference in exposure of these seed orchards to pest attack or may be the clones were more resistant to borer attack.

3064 Santosh, K; Kumar, P. 2003. **New incidence of *Alcterogystia cadambae* Moore. (Lepidoptera: Cossidae) on *Butea monosperma* Taub**. Myforest 39(1): 89-91.

It is reported that *Butea monosperma* trees growing naturally in and around teak plantations were found infested by *A. cadambae*, the trunk borer.

3065 Sarvottam Rao, C. 1968. **Identification and control of insect borer in teak plantation-Itkial range-Pembi**. Indian Forester 94(8): 649-650.

The root and shoot boring insect has been identified as *Calesterna scabrator*. Certain silvicultural measures are suggested for the control.

3066 Schmidt, H. 1968. **A test method with the subterranean termite *Reticulitermes* on tropical woods**. (German). Holz als Roh-und Werkstoff 26(9): 342-343.

The termite-repellent properties of many tropical timbers delay the onset of attack. Tests with *R. flavipes* on 7 timbers including teak from Thailand are described. *Tectona grandis* was attacked after two years.

3067 Scott, C.W. 1932. **Measurement of the damage to teak timber by the beehole borer moth, *Xyleutes* (*Duomitus caramicus*) with special reference to relative severity in plantations and natural forest and to variation with rainfall and position in the tree**. Burma Forest Bulletin 29 (Economic series 6): 10p.

Damage which is proportional to rainfall and also to increasing altitude. Plantation teak is more bee-holed than natural forest teak and this rainfall index can be used for gauging value of teak plantations, bee-hole damage and for raising plantations.

3068 Sen Sarma, P.K; Thakur, M.L; Misra, S.C; Gupta, B.K. 1975. **Studies on wood destroying termites in relation to natural termite resistance of timber**. Final Technical Report 1968-73: 187p. Forest Research Institute, Dehra Dun.

This report dealt with the identity, distribution and economic significance of wood destroying termites, with the mass-rearing of *Neotermes bosei* Snyder, *Coptotermes heimi* and *Microcerotermes beesoni* Snyder, with the selection of teak trees with a high termite resistance index, with the natural resistance of timber to termites.

3069 Sevastopulo, D.G. 1951. **A supplementary list of the food plants of the Indian Bombycidae and Agaristidae and Noctuidae**. Journal of the Bombay Natural History Society 48: p271.

Teak is reported as the host plant of *Cossus cadambae*.

3070 Silva, M.D de. 1961. ***Empoasca punjabensis* Pruthi, a newly recorded pest of teak in Ceylon**. Tropical Agriculturist, Ceylon 117(3): 203-204.

A note on this leafhopper, found causing malformations of teak leaves.

3071 Singh, B. 1955. **Description and systematic position of larva and pupa of the teak defoliator, *Hyblaea puera* Cramer (Insecta, Lepidoptera, Hyblaeidae)**. Indian Forest Records (n.s.) Entomology 9(1): 1-16.

The study justifies the erection of the family Hyblaeidae for the genus *Hyblaea*, and its separation from the *Noctuidae*.

3072 Singh, P; Misra, R.M. 1987. **New record of *Beauveria tenella* (Delacroix) Siemaszko on teak skeletonizer *Eutectona machaeralis* Walker (Lepidoptera: Pyralidae)**. Indian Forester 113(7): 476-478.

An investigation of the chronic and severe epidemics of *Eutectona machaeralis* which occur in the teak forests of Melghat, Maharashtra was made. The progressive changes occurring after spraying fungal spores onto larvae in the laboratory are described. It is suggested that *B. tenella* could be used successfully in biological control of *E. machaeralis*.

3073 Singh, P; Misra, R.M; Singh, R. 1990. **External morphology, bionomics and natural enemies of *Pagyda salvalis* Walker (Lepidoptera: Pyralidae) the inflorescence feeder and fruit borer of teak**. Indian Forester 116(9): 742-747.

Observations of *P. salvalis* are reported based on insect studies and field surveys carried out in teak forests in Uttar Pradesh, Tamil Nadu and Maharashtra. Three generations were recorded from June to October, and the pest was observed feeding on *Callicarpa lantana* and on teak.

3074 Singh, S; Puri, Y.N; Bakshi, B.K. 1973. **Decay in relation to management of dry coppice teak forests**. Indian Forester 99(7): 421-430.

In studies in two cutting areas in Gujarat State, where trees were coppiced at six different heights of 0, 5.25 cm above ground. Stools coppiced at heights of 10-15 cm produced the largest number of low side shoots and the fewest high side shoots or callus shoots, and this height is recommended for further coppicing.

3075 Soda, R; Nakamura, K; Matsune, K; Nakama, E; Harada, Y; Sasaki, S. 2000. **Insect damage on mahogany and teak trees in East Kalimantan, Indonesia**. Bio technology applications for reforestation and biodiversity conservation. Proceedings of the 8th International Workshop of BIO REFOR, Kathmandu, Nepal, 28 November-2 December 1999: 109-111. M.S. Bista; R.B. Joshi; S.M. Amatya; A.V. Parajuli; M.K. Adhikari; H.K. Saiju; R. Thakur; K. Suzuki; K. Ishii, Eds. BIO REFOR, Ministry of Forests and Soil Conservation, Kathmandu, Nepal.

Teak beehole borer, *Xyleutes ceramica* which damages teak stems. Sixteen percent of 5-yr-old teak trees were damaged. The insect made holes in the bottom of stem and many holes were observed in the heartwood.

3076 Speight, M.R. 1996. **The relationship between host tree stresses and insect attack in tropical forest plantations and its relevance to pest management**. Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium, Peechi, India, 23-26 November 1993: 363-372. K.S.S. Nair; J.K. Sharma; R.V. Varma, Eds. Kerala Forest Research Institute, Peechi, India.

The role of stress originating from environmental factors in insect-host interactions in tropical trees is discussed and the literature reviewed. A computer-based site-matching system was used to investigate the suitability of the five sites to the chosen tree species. In four of the five cases, the trees attacked by insects were growing in environment not suited for the trees. The importance of pest management by preventative means which involve the minimising of risk from insect attack at the planning stage is emphasised.

3077 Sri Esti Intari. 1978. **Some important pests of forest trees in Indonesia**. Proceedings of the 8th World Forestry Congress, Jakarta, 16-28 October 1978, World Forestry Congress: Forestry for industrial development FID-0-11: 6p.

Brief notes are given on Neotermes tectonae, Pyrausta machaeralis and Hyblaea puera on Tectona grandis.

3078 Srinivasan, T.K. 1955. **Crustaceans in relation to underwater timber structures**. Current Science 24(10): p342.

A survey was made of crustaceans associated with underwater timbers of the Madras coast. The most important borers are *Sphoerama vastator, S. walkeri, Exosphoeroma* sp. and *Metoponorthus pruinosus* which damage structures of species including teak.

3079 Starte, H.W. 1926. **Rats attacking teak seedlings**. Indian Forester 52(3): 132-133.

Reports teak seedlings upto 1" diameter or more nibbled by rats at collar level.

3080 Stebbing, E.P. 1899. **Injurious insects of Indian forests**. *Hapalia machaeralis*: p115; 119-121, *Hyblaea puera*: 115-117; 120-132, *Cossus cadambae*: 102-104. Government of India Press, Calcutta.

Gives notes on Hapalia machaeralis, Hyblaea puera and Cossus cadambae attacking teak forests.

3081 Stebbing, E.P. 1901. **Forest Pests. I. Teak tree pests**. Indian Forester 26(5): p391; 516-517, 27(5): 72-74; 243; 247-248.

3082 Stebbing, E.P. 1902. **Injurious insects of Indian forests**. Indian Forester 28: 389-390.

Covered insect pests of teak.

3083 Stebbing, E.P. 1903. **Forests pests I. Teak tree pests *Hyblaea puera***. Indian Forester 29(5): p183.

3084 Stebbing, E.P. 1903. **The insect world in an Indian forest and how to study it. Part VI**. Indian Forester 29(5): 178-186.

The various families in the sub-order are described and *Cossus cadambae* is listed as harmful to teak.

3085 Stebbing, E.P. 1905. **A note on the beehole borer of teak in Burma**. Indian Forest Bulletin (Entomology Series) 1: 1-19.

3086 Stebbing, E.P. 1907. ***Icerya aegyptica*, Dougl. on teak in Burma**. Indian Forester 33(5): 222-224.

3087 Stebbing, E.P. 1908. **The teak defoliator**. Indian Forest Leaflet (Zoology Series) 2: 5p.

Describes the nature of attack, distribution, general appearance, damage committed in forest, natural enemies and protection of *Hyblaea puera*.

3088 Stebbing, E.P. 1908. **The teak leaf skeletioniser**. Indian Forest Leaflet (Zoology Series) 3: 8p.

Describes the nature of attack, distribution, general appearance, damage committed in forest, natural enemies and protection of *Pyrausta machaeralis*.

3089 Stebbing, E.P. 1915. **Indian forest Coleoptera**. Tectona 8: 566-570.

Attack with partial to complete defoliation causing curling and gall formation on undersurface of leaves, later upper surface, blackens, decays or drops.

3090 Sudheendrakumar, V.V. 1986. **Studies on the natural enemies of the teak pests, *Hyblaea puera* and *Eutectona machaeralis***. KFRI Research Report 38: 28p. Kerala Forest Research Institute, Peechi.

The natural enemies include five parasites - *Brachymeria lasus, Palexorista solennis, Sympiesis* sp. and two species of unidentified ichneumonid wasps, two insect predators, four species of birds and a species of bacterial pathogen *Enterobacter aerogenes*.

3091 Sudheendrakumar, V.V; Nair, K.S.S; Varma, R.V. 1988. **Seasonal incidence of *Eutectona machaeralis* (Walker) in teak plantations at Nilambur, Kerala**. Indian Journal of Forestry 11(3): 250-253.

Seasonal incidence was studied by visual scoring of the defoliation. It is reported that late season outbreaks of *E. machaeralis* are not regular phenomenon in teak plantations in Kerala and that outbreak may be heavy and widespread in exceptional years.

3092 Sudheendrakumar, V.V; Ali, M.I.M; Varma, R.V. 1988. **Nuclear polyhedrosis virus of the teak defoliator, *Hyblaea puera***. Journal of Invertebrate Pathology 51(3): 307-308.

The pathogens of *Hyblaea puera* were surveyed in teak plantations in Kerala. A nuclear polyhedrosis virus was isolated from dead larvae and its pathogenicity was confirmed in the laboratory.

3093 Sudheendrakumar, V.V; Ali, M.I.M; Mohanadas, K. 1990. **Studies on the bacterial pathogens associated with the teak defoliator, *Hyblaea puera* Cramer**. Proceedings of the IUFRO Regional Workshop on Pest and Diseases of Forest Plantations, Bangkok, 1988: 1-4. C. Hutacharern, et al, Eds. FORSPA, Bangkok.

Four bacteria, *Bacillus thuringiensis, Enterobacter aerogenes, Serratia marcescens* and *Pseudomonas aeruginosa* were isolated in pure culture and pathogenicity confirmed in artificial inoculation trials. Preliminary laboratory studies indicated that *B. thuringiensis* is the most effective bacterium causing mortality of the larvae of *H. puera*. Potential of these organisms in biological control of *H. puera* is discussed.

3094 Sudheendrakumar, V.V. 1994. **Pest of teak and their management**. Forest Entomology: 121-140. L.K. Jha; P.K. Sen Sharma, Eds. Ashish Publishing House, New Delhi.

About 171 species of insects are associated with living teak. The pests of teak can be divided into two groups, leaf feeders and trunk borers. The leaf feeders include the lepidoptera, *Hyblaea puera* and *Eutectona machaeralis*. The trunk borers include *Sahyadrassus malabaricus* and *Alcterogystia cadambae*. The biology, seasonal incidence pattern, impact and control strategies of the important pests are discussed in this paper.

3095 Sudheendrakumar, V.V; Jalali, S.K; Singh, S.P. 1995. **Acceptance of the teak defoliator, *Hyblaea puera* (Cramer) (Lepidoptera: Hyblaeidae) by two exotic species of *Trichogramma* (Hynenoptera: Trichogrammatidae)**. Journal of Biological Control 1: 43-44.

Two arboreal species of *Trichogramma* namely, *T. embryophagum* and *T. dendrolimi* were evaluated in the laboratory for their efficacy in parasitising the teak defoliator eggs. Parasitism caused by *T. embyophagum* was significantly higher than that of *T. dendrolimi* and the highest parasitism occurred under the parasitoid - host ratio of 1:4.

3096 Sudheendrakumar, V.V. 2003. **Reproductive behaviour of *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidae)**. Entomon 28(2): 77-84.

The reproductive behaviour of the teak defoliator, *Hyblaea puera* was studied under laboratory conditions.

3097 Suharti, M; Intari, S.E. 1974. **Guide to the identification of several pests and diseases of teak (*Tectona grandis*)**. Laporan, Lembaga Penelitian Hutan 182: 42p.

3098 Sundararaj, R; Remadevi, O.K; Rajamuthukrishnan. 2000. **Intensity of whitefly *Aleurodicus dispersus* Russell (Aleyrodidae: Homoptera) on forest and avenue trees in and around Bangalore (India)**. Indian Journal of Forestry 23(3): 319-321.

Eggs, nymphs and adults of the while fly, *Aleurodicus dispersus* were observed infesting the leaves of important avenue trees and forest tree species in Karnataka especially teak.

3099 Supriana, N. 1988. **Feeding preference behaviour of *Cryptotermes cynocephalus* Light and *Coptotermes curvignathus* Holmgren on twenty eight tropical timbers**. Jurnal Penelitian dan Pengembangan Kehutanan 4(2): 1-5.

A study was made of the comparative resistance and repellency of 28 tropical timbers to the dry wood termite, *Cryptotermes cynocephalus* and the subterranean termite, *Coptotermes curvignathus*. The most repellent species to *C. cynocephalus* include *Tectona grandis*. The relation of the results to the relative hardness of the wood species is discussed.

3100 Suratmo, F.G. 1982. **Pest management in forestry**. Protection Ecology 4(3): 291-296.

Progress in forest pest management in Thailand, Malaysia, Philippines and Indonesia is reviewed and the widespread insect pests of certain forest trees including teak are discussed in relation to the damage caused by them. The current development of industrial monoculture plantations in South-East Asia is likely to result in greater pest problems, increasing the need for improved forest pest management activity in the region.

3101 Suratmo, F.G. 1996. **Emerging insect pest problems in tropical plantation forest in Indonesia**. Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium, Peechi, 23-26 November 1993: 502-506. K.S.S. Nair; J.K. Sharma; R.V. Varma, Eds. Kerala Forest Research Institute, Peechi.

Plantations of forest trees including teak have been raised in Indonesia for more than 100 years. Several insect pests are reported to attack these plantations, which include *Xyleborus destruens*, *Hyblaea puera*, *Pyrausta machaeralis* and termites on teak. Insect pest problems of these species are discussed.

3102 Sushil Kumar; Thakur, M.I. 1989. **Damage to nursery stock by a rodent *Nesokia indica* (Gray) at Satyanarayan Forest Nursery, Dehra Dun (Uttar Pradesh)**. Indian Forester 115(3): 177-179.

A brief account of the nature and extent of damage caused by the rat, *N. indica* to stock at the nursery is given. Damage was found to the tap roots of newly germinated and 1-yr-old seedlings of trees including *Tectona grandis*.

3103 Swaran, P.R; Varma, R.V. 2001. **Root feeding termites - an emerging problem in root trainer raised teak seedlings in Kerala**. Annals of Forestry 9(2): 331-332.

Over 20 percent of the out-planted seedlings were found either killed or severely damaged by subterranean termites.

3104 Szen, I.S.T; Vany, J.J.H; Womersley, J.S. 1958. **Some Insects in forest trees of New Guinea**. Proceedings of the 10th International Congress Entomology Montreal. 1956 4: 331-334.

Hyblaea puera is the important pest of teak.

3105 Thakur, M.L. 1983. **Insect factor in forest tree improvement programme**. Journal of the Indian Academy of Wood Science 14(1): 26-34.

A review of current pest problems of forest trees including *Tectona grandis* and a discussion of the role of tree breeding in prevention and control.

3106 Thakur, R.K; Rathore, N.S. 1982. **On the occurrence of *Cryptotermes bengalensis* Snyder (Isoptera: Kalotermitidae) in Gujarat, India**. Journal of the Bombay Natural History Society 79(3): 699-700.

Cryptotermes bengalensis was found attacking dead portions of a living teak in the Kaprada Forests, Bulsar District, Gujarat and this is of the first record of the termite from the state.

3107 Thompson, R.C. 1897. **Insect ravages among teak and *Anogeissus latifolia***. Indian Forester 23: p325.

3108 Tilakaratna, D. 1995. **Life history of the teak defoliator, *Hyblaea puera***. Sri Lanka Forester 22(1/2): 25-28.

The life history of *Hyblaea puera* was studied under the laboratory conditions with the objective of determining the duration and behaviour of various stages of the insect's life under Sri Lankan conditions. It was found that the complete life cycle takes 21-33 days.

3109 Tiwari, S.D.N. 1954. **The sapling borer of teak**. Indian Forester 80(8): 433-434.

A short note on a new cerambycid borer, found in teak plantations in Bastar State, which has been identified as *Coelosterna* sp.

3110 Tiwari, S.D.N. 1958. **Teak defoliator**. Indian Forester 84(10): p647.

Mentions about teak defoliation occurring in high intensity attributed to drought. Abundance of *Hapalia mechaeralis* is attributed to the climate of the locality.

3111 Troup, R.S. 1901. **A teak-boring molluse**. Indian Forester 27(10): p492.

Martesia fluminalis reported from brackish waters of Pegu canal, Lower Burma, is said to cause damage of stored teak logs. The animal is found in the cross-section of wood in a cavity, which shows that it gets in when small and grows bigger inside.

3112 Vaishampayan, S.M; Verma, R; Bhowmik, A.K. 1987. **Possible migration of teak-defoliator, *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidae) in relation to the movement of the south-west monsoon as indicated by light trap catches**. Indian Journal of Agricultural Sciences 57(1): 41-46.

Light trap data showed that the activity of *H. puera* in the teak forests of E. Madhya Pradesh was closely linked with the movement of the monsoon. Moths first appeared with the arrival of the monsoon. Delay in the arrival of the monsoon reduced pest activity.

3113 Varma, B.A; Sudhakara, K; Bhaskar, B. 1996. **Insect pests associated with nurseries of selected tree crops in Kerala**. Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium, Peechi, 23-26 November 1993: 468-473. K.S.S. Nair; J.K. Sharma; R.V. Varma, Eds. Kerala Forest Research Institute, Peechi.

Seven tree species raised in the nursery which include *Tectona grandis* suffered greater pest damage. Most damage was caused by leaf feeding and root feeding insects such as *Hyblaea puera*, *Eligma narcissus* and *Eurema blanda*.

3114 Varma, R.V. 1997. **White grub damage and its control in teak nurseries**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 84-85. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

White grubs cause serious damage to teak seedlings in many nurseries. Two organophosphate insecticides - Phorate 10G and Carbofuran 3G were tested in a white grub infested teak nursery and the insecticides proved effective in preventing further damage.

3115 Varma, R.V; Sudheendrakumar, V.V; Nair, K.S.S; Mohanadas, K. 1998. **Establishment of permanent plots to demonstrate the effect of protecting teak plantations from the teak defoliator**. KFRI Research Report 163: 15p. Kerala Forest Research Institute, Peechi.

Permanent plots were established and maintained in a young teak plantation at panayangode in the Nilambur Forest Division to demonstrate the impact of defoliation caused by the insect *Hyblaea puera* on growth of teak. In the protected plot there was 45 percent increase in mean height and 19 per cent increase in GBH over the control.

3116 Varma, R.V; Sudheendrakumar, V.V; Sajeev, T.V. 2001. **Assessment of pest problems in intensively managed STM teak plantations**. KFRI Research Report 198: 12p. Kerala Forest Research Institute, Peechi.

A study was made to identify and the impact of major pests in intensively managed teak plantations of Sterling Tree Magnum Company and to examine how the intensive management practices like irrigation and fertilizer applications affect the pest dynamics. The major pests recorded were the teak defoliator, *Hyblaea puera* and the teak skeletonizer, *Eutectona machaeralis*.

3117 Vastrad, A.S; Rai, P.S; Kulkarni, K.A. 1989. **Occurrence of *Eucoptacra ceylonica* Kirby (Coptacridinae: Acrididae: Orthoptera) in India**. Entomon 14(3/4): 277-279.

Eucoptacra ceylonica was recorded for the first time in India and the adults were found feeding on the leaves of plants including *Tectona grandis*. A key to the species of the genus *Eucoptacra* is provided.

3118 Veenakumari, K; Mohanraj, P. 1996. **Folivorous insects damaging teak, *Tectona grandis* Linn.f. (Verbenaceae) in the Andaman Islands, Bay of Bengal, Indian Ocean**. Journal of Entomological Research 20(2): 177-178.

Teak was introduced into the Andaman and Nicobar Islands. It was recorded to be extensively damaged by the lepidopteran teak defoliator, *Hyblaea puera*.

3119 Verbeek, F.A.T.H. 1930. **The teak defoliator *Hyblaea puera* Cram**. (Dutch; English). Tectona 33: 104-112.

3120 Villar, A.R. 1916. **Beehole borers and a tucktoo**. Indian Forester 42(10): 512-514.

Describes the life history, stages and behaviour of the moth *Duomitus ceramicus*. The high mortality of the moths and eggs is attributed to a tucktoo, a friend of forests of Burma.

3121 Wang, P.Y; Sung, S.M. 1980. **On taxonomic status of the teak leaf skeletonizer, *Pyrausta machaeralis* Walker, with establishment of a new genus**. (Chinese; English). Acta Entomologica Sinica 23(3): 305-307.

Pyrausta machaeralis, an important pest of teak in tropical Asia. The characters of the genus are given.

3122 Wu, S.H; Chen, C.C; Wang, T.H. 1979. **A preliminary study on the teak defoliator *Pyrausta machaeralis* Walker**. Acta Entomologica Sinica 22(2): 156-163.

Larvae spun webs and fed on leaf tissues between veins. Adults stay in shade. A total of 18 species of natural enemies were found in the field.

3123 Wu, W.N; Li, Z.Q. 1984. **Three new species of the genus Phytoseius from South China (Acarina: Phytoseiidae)**. Acta Entomologica Sinica 27(4): 457-461.

The species include P. silvaticus from Tectona grandis.

3124 Yadav, A.S; Khare, P.K. 1988. **Observations on insect attack, leaf-fall and leafing period in teak**. Canopy International 14(1): p11.

A brief report on the infestation of teak in a tropical dry deciduous site at Gopalpura reserved forest, Madhya Pradesh, by the teak defoliator, *Hyblaea puera* and the teak skeletonizer, *Hapalia machaeralis*.

3125 Yeole, P.R. 1991. **Teak girdler larva**. Indian Forester 117(4): 286-287.

An infestation by an unidentified larva is reported from a teak seed orchard in Mohogata Research Centre, Maharashtra which was found in the soil at the base of the trees is briefly described.

3126 Zethner, O. 1970. **Defoliations of teak by *Hyblaea puera* Cr. in East Pakistan**. Forest Dale News 2(4): 45-49.

Data on the serious damage to teak plantations caused by *H. puera* in parts of Chittagong.

3127 Zethner, O. 1973. **Entomological problems in forests in the Indian subcontinent with examples from Pakistan and Bangladesh**. Entomologiske Meddelelser 41(3): 129-143.

Reviews and discusses the different types of forests in these regions and the principal insect pests that attack the trees. The most important insect pests that attack logs and other felled wood, plantations and nurseries are enumerated.

3128 Zethner, O; Choudhury, J; Das Gupta S.R. 1972. **Preliminary studies on forest insects in East Bengal**. FAO Report FAO: UNDP-66-530: 40p.

A compilation of four papers which include the paper entitled, a note on distribution and control of teak defoliators in Bangladesh. *H. puera* and *Hapalia machaeralis* are the important defoliators of *Tectona grandis*. A list is given of trees and shrubs suitable for introduction into teak plantations in order to provide a source of insect hosts to maintain a population of parasites.

Go top

Go top

Biological Control

(See also 3090)

3129 Agarwal, G.P; Rajak, R.C; Katare, P; Sandhu, S.S. 1985. **Studies on entomogenous fungi parasitizing insect pests of teak**. Journal of Tropical Forestry 1(1): 91-94.

The fungi *Beauveria bassiana* and *Fusarium* sp. were isolated from *Hyblaea puera* and *Pyrausta machaeralis* in Jabalpur, Madhya Pradesh. Healthy, laboratory-reared eggs, larvae, pupae and moths were sprayed with a suspension of conidial spores. *Fusarium* was found more effective against both moths.

3130 Ahmed, S.I. 1995. **Investigations on the nuclear polyhedrosis of teak defoliator, *Hyblaea puera* (Cram) (Lep., Hyblaeidae)**. Journal of Applied Entomology 119(5): 351-354.

Laboratory studies were carried out on the infection of *Hyblaea puera* with nuclear polyhedrosis virus to gain an understanding of the insect-virus relationship.

3131 Ali, M.I.M; Sudheendrakumar, V.V. 1997. **Possible use of microbial pathogens against teak pests**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 93-99. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

A disease of the teak defoliator *Hyblaea puera* caused by a nuclear polyhedral virus was observed in various teak plantations. Bioassay studies revealed that the virus is highly pathogenic to *H. puera*. Three species of bacterial pathogens, viz. Bacillus cereus, *B. thuringiensis* var *thuringiensis* and *Enterobacter aerogenes* were also recorded from *H. puera*. The fungal pathogen *Beauveria bassiana* was found to cause larval mortality of the teak sapling borer *Sahyadrassus malabaricus*.

3132 Ali, M.I.M; Varma, R.V; Sudheendrakumar, V.V. 1991. **Evaluation of microbial pathogens for biocontrol against important insect pests of Ailanthus and teak**. KFRI Research Report 72: 44p. Kerala Forest Research Institute, Peechi.

The results are reported of laboratory tests carried out on the potential effectiveness in biological control of viral, fungal and bacterial pathogens isolated from pests of teak and *Ailanthus triphysa* in Kerala. The teak pests studied were the teak defoliator, *Hyblaea puera* and the teak sapling borer, *Sahyadrassus malabaricus*.

3133 Atkinson, D.J. 1933. **On life history, analysis of past attacks and natural enemies**. Burma Annual Report on working plans, Silviculture and Entomology for 1931-32: 61-65.

3134 Atkinson, D.J. 1933. **Preliminary note on the shot-holing of converted teak**. Indian Forester 59(4); 226-232.

Notes on shot-holing of teak, attributed to *Tribolium castaneum* and *Dinoderus pilifrons* and *Xyleborus* spp. and other ambrosia beetles of family Platypodidae, etc. is given.

3135 Beeson, C.F.C. 1934. **The biological control of teak defoliators**. Indian Forester 60(10): 672-683.

The author recommends use of natural remedies to control defoliation.

3136 Beeson, C.F.C. 1938. **Undergrowth and the biological control of teak defoliators**. Indian Forester 64(8): 485-492.

The value of undergrowth in biological control of defoliators in teak plantations was investigated and listed species of useful plants based on host-parasite relationships.

3137 Beeson, C.F.C; Chatterjee, P.N. 1939. **Further notes on the biology of parasites of teak defoliators in India**. Indian Forest Records (n.s.) Entomology 5: 355-379.

Additional data on distribution, hosts, life-cycles, etc. are given for 23 hymenopterous and 6 dipterous species of parasites of teak defoliators in India. Experiments in the introduction and colonization of parasites between Burma and India and vice versa are described. Data are recorded on the parasitism percentages of *Hapalia machaeralis*, *Hyblaea puera*, *Lygropia quaternalis* and *Sylepta* spp.

3138 Bhatia, B.M. 1941. **On the plant-defoliator-parasite complex in the biological control of teak defoliators**. (English). Indian Forest Records 7(6): 193-211 .

Gives a list of host plants for association with teak for the biological control of two chief defoliators *Hapalia machaeralis* and *Hyblaea puera*.

3139 Braithwaite, J.D. 1942. **Notes on research into the parasite of the beehole borer of teak**. Empire Forestry Journal 21: 120-122.

The author describes some successful laboratory experiments in the breeding of *Nemeritris tectonae*, the first ever undertaken with this species.

3140 Chadhar, S.K. 1996. **Field evaluation of *Bacillus thuringiensis* (a biopesticide) in relation to control of teak skeletoniser**. Vaniki Sandesh 20(1): 1-6.

A 6-yr-old plantation of teak in Madhya Pradesh, infested with the teak skeletonizer, *Pyrausta machaeralis*, were treated with *Bacillus thuringiensis* spray . Leaves affected by the pest were counted before and after treatment in control and treated plots. Differences in the percentage of leaves skeletonized were marginal between the treatments.

3141 Chatterjee, P.N. 1938. **Cytoplasmic inclusions in the cogenesis of *Apenteles machaeralis*, a background parasite of teak caterpillar *Hapalia machaeralis***. Allehabad University Studies (Zoology Series) 15: 26p.

3142 Chatterjee, P.N. 1951. **The A.B.C. of the problem of biological control of teak defoliators**. Madras Forest College Magazine: 127-132.

Serious defoliation by *Hapalia machaeralis* and *Hyblaea puera* occurs during the post monsoon and pre-monsoon periods respectively every year in the teak plantations. This paper gives briefly the information on the biological control complex of teak defoliators. Host-parasite relations, alternative hosts, parasite-predators, requirements of food, shelter, resting etc. are touched generally. A list of the desirable plants indexed according to parasite value is also included. Mention is made of the liberation of *Cedria paradoxa*.

3143 Choudhury, J.C.B; Misra, M.P. 1981. ***Chaenus rayotus* Bates (Coleoptera: Carabidae: Chlaeniini) - a new predator of *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidae) from Walayar Reserve Forests, Kerala State**. Indian Forester 107(1): 63-65.

Defoliation of teak by *H. puera* was effectively checked by this predator in association with the tachinid *Sturmia inconspicuella*, a potential for biological control is suggested.

3144 Forest Department, Burma. 1949. ***Nemeritis tectonae*, parasite of *Xyleutes ceramica*, the beehole borer of teak**. Report of Working Plans Silvicultural Entomology, Forest Department, Burma 1940-1: 85-86.

The relationship between stem girth of the tree and parasitism of the beehole borer was confirmed, graphs showing this to be inverse. In some areas the rate of parasitism in 2- and 3-year-old shoots on the top branches is as much as 90 percent falling towards the main stem where it sinks to 10-15 percent .

3145 Garthwaite, P.F; Desai, M.H. 1939. **On the biology of the parasites of the teak defoliators, *Hapalia machaeralis* Walk. (Pyralidae) and *Hyblaea puera* Cram. (Hyblaeidae) in Burma**. Indian Forest Records (n.s.) Entomology 5: 309-353.

One hundred and sixteen species of parasites bred out of material of these two insects are dealt with, of these 47 species are primary parasites of *Hapalia machaeralis* and 29 species are primary on *Hyblaea puera*, 11 species being common to both. The method of breeding *Apanteles machaeralis* in the insectary is described.

3146 Gotoh, T; Yincharoen, S; Eungwijarnpanya, S; Hutacharern, C. 2002. **Strategies for the management of the teak beehole borer, *Xyleutes ceramicus* (Walker) (Lepidoptera: Cossidae) in Thailand**. Proceedings of the IUFRO FAO Workshop on Pest Management in Tropical Forest Plantations, Chanthaburi, Thailand, 25-29 May 1998. C. Hutacharen; B. Napompeth; G. Allard; F.R. Wylie, Eds. FORSPA-Publication 30: 99-103. FAO Regional Office for Asia and the Pacific, Bangkok.

The ecology of the teak beehole borer, *Xyleutes ceramicus*, which was studied in northern Thailand. Natural regulation mechanisms were clarified through life table construction. Key factor analysis showed that predation by ants during the egg and the 2nd to 3rd larval stages governs the population changes of the borer.

3147 Intachat, J; Mastura, M; Staines, H. 2000. **Evaluation on the toxicity effect of four *Bacillus thuringiensis* strains against the teak skeletoniser, *Paliga damastesalis* Walker (Lepidoptera: Pyraloidea: Crambidae)**. Journal of Tropical Forest Science 12(3): 425-430.

Four *Bacillus thuringiensis* strains namely: HD-1, Florbac, SN-2 and SN-5, were screened against the 3rd instar of the teak skeletonizer, *Paliga damastesalis*. Bt subspecies aizawai (strain SN-2) was found to be the most effective in controlling the teak skeletonizer larvae.

3148 Intachat, J; Mastura, M; Staines, H. 2000. **The effectiveness of two commercial formulations and SN-2 strain of *Bacillus thuringiensis* against the teak skeletoniser, *Paliga damastesalis***. Journal of Tropical Forest Science 12(4): 804-806.

The effectiveness of a radiation-resistant strain of *Bacillus thuringiensis*, SN-2 strain, was compared with that of 2 commercial formulations after exposure of 125 teak skelotoniser larvae. The mean percentage mortality for SN-2 was approximately twice that for both commercial formulations. The increased effectiveness, sustained over time, and quicker response of SN-2 over current *B. thuringiensis* formulations make this an attractive approach to controlling the teak skeletonizer.

3149 Kalia, S; Harsh, N.S.K; Joshi, K.C. 1998. **Pathogenic fungus of *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidae) a major pest of *Tectona grandis***. Indian Forester 124(8): 671-672.

Two fungal species, *Aspergillus flavus* and *A. niger*, were isolated from dead and moribund larvae of *Hyblaea puera* on teak. Tests of pathogenicity of the fungi showed that only *A. flavus* was pathogenic.

3150 Kalia, S; Harsh, N.S.K. 2003. ***Metarhizium anisopliae* (Metschnikoff) Sorokin pathogenic to the larvae of teak defoliator, *Hyblaea puera* Cramer**. Journal of Entomological Research 27(2): 135-136.

Metarhizium anisopliae was isolated from the larval instars of the teak defoliator, *H. puera*. The fungus exhibited pathogenicity to larval instars of teak defoliator in the laboratory.

3151 Kalia, S; Lall, R.B; Kalia, S. 2000. **Efficacy of three varietal toxins of *Bacillus thuringiensis* tested against some important forest insect pests of multipurpose forest tree species**. Indian Forester 126(1): 62-66.

The effectiveness of 3 varietal toxins of *Bacillus thuringiensis* var. thuringiensis and 2 products of var. *kurstaki*, LDC and Dipel were tested against 10 important insect pests of forest trees. The results indicate that all the defoliators are highly susceptible to the microbial pesticide *B. thuringiensis*, and that spraying the pesticide at 1.5 percent concentration was the most effective in controlling the pests irrespective of the toxin preparations used.

3152 Kalia, S; Pant, N.C. 1999. **Susceptibility of larvae of *Eutectona machaeralis* to two varietal toxins of *Bacillus thuringiensis***. Journal of Tropical Forest Science 11(3): 570-573.

Experiments were laid out to test the efficacy of toxins of *Bacillus thuringiensis* from 2 varieties against the teak leaf skeletoniser, *Eutectona machaeralis*. The pest showed high susceptibility to both toxins, but was more susceptible to that of *B. thuringiensis* sub sp. *dendrolimus*.

3153 Kalshoven, L.G.E. 1960. **Observations on the parasites of *Xyleborus* (twig borers) in Java**. Entomologische Berichten, Amsterdam 20(12): 259-262.

Describes observations on a chalcid of the genus *Tetrastichus* attacking *Xyleborus morigerus* in teak and also *Xyleborus morstatti* and another parasite, presumed to belong to the Proctotrypoidea.

3154 Khan, A.H; Chatterjee, P.N. 1944. **Undergrowth in teak plantations as a factor in reducing defoliation**. Indian Forester 70(11): 365-369.

The chief factors controlling the teak defoliators, *Hyblaea puera* and *Hapalia machaeralis* have been found to be climate and parasitic and predaceous insects. The main object of the study reported in this paper was to determine the relative effectiveness of parasitism of teak defoliators.

3155 Kijker, S. 2001. **Timber plantation development in Thailand**. Proceedings of the International Conference on Timber Plantation Development, Manila, Philippines, 7-9 November 2000: 263-273. Department of Environment and Natural Resources, Quezon City, Philippines.

3156 Kulkarni, N; Joshi, K.C; Gupta, B.N. 1997. **Antifeedant property of *Lantana camara* var. *aculeata* and *Aloe vera* leaves against teak skeletonizer, *Eutectona machaeralis* Walk. (Lepidoptera: Pyralidae)**. Entomon 22(1): 61-65.

Methanolic leaf extracts of two plants *Aloe vera* and *Lantana camara* var. *aculeata* were screened for antifeedant properties against *Eutectona machaeralis* at various concentrations. Extracts of both plants were equally effective in reducing the food consumption rate.

3157 Livingstone, D; Yacoob, M.H.S; Bai, S.J. 1982. **A report on *Erythmelus empoascae*, a Mymarid egg parasite of the teak tingid *Pontanus puerilis* Drake & Poor (Heteroptera: Tingidae)**. Journal of the Indian Academy of Wood Science 13(1): 27-29.

The parasite/host relationship of *E. empoascae*/*P. puerilis* is recorded here for the first time. Brief information is given on the nature of the parasitization, infestation and distribution of the parasite in South India.

3158 Loganathan, J; David, P.M.M. 1999. **Natural parasitism in teak defoliator, *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidae) in intensively managed plantation**. Journal of Biological Control 13(1/2): 115-120.

Parasitism in teak defoliator, *Hyblaea puera* was studied in an intensively managed teak plantation in Tamil Nadu. Parasitism by *P. solennis* suppressed the defoliator larval population in the fourth generation.

3159 Loganathan, J; David, P.M.M. 1999. **Predator complex of the teak defoliator, *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidae) in an intensively managed teak plantation at Veeravanallur, Tamil Nadu**. Entomon 24(3): 259-263.

A detailed survey was made in a 3-year-old intensively managed teak plantation to understand the predator complex of defoliator, *Hyblaea puera*. Seventeen species of spiders, five species of carabids, four species of bugs and eight species of birds were identified as predators on defoliators.

3160 Loganathan, J; David, P.M.M. 1999. **Sticky weeds as an understorey vegetation in intensively managed teak plantation for defoliator management**. Crop Protection 18(9): 577-580.

In an intensively managed commercial teak plantation in Tamil Nadu wild undergrowth of two malvaceous weed species, namely, *Pavonia odorata* and *Pavonia zeylanica* trapped larvae of the teak defoliator, *Hyblaea puera*. Artificial introduction of defoliator larvae on these 'bio-trap plants' showed arrested movement of larvae with over 80 percent mortality of first and second instar one day after release.

3161 Loganathan, J; David, P.M.M. 2000. **Laboratory and field evaluation of *Bacillus thuringiensis* Berliner products against the teak defoliator, *Hyblaea puera* Cramer**. Insect Science and its Application 20(1): 61-65.

Commercial *Bacillus thuringiensis* Berliner products, namely Delfin R, Agree R, Halt R and Spicturin R were evaluated in the laboratory and on an intensively managed teak plantation in Tamil Nadu for the control of the teak defoliator, *Hyblaea puera*. A 2 g/litre concentration showed highly significant lethality against defoliator larvae.

3162 Mathew, G. 2003. **Feasibility of biological control of forest insect pests - An assessment with teak defoliator management as an example**. Biological control of insect pests: 127-131. S. Ignasimuthu; S. Jayaraj, Eds. Phoenix Publishing House, Delhi.

Biological control of insect pests is the most acceptable form of pest management in forest ecosystems. For successful management, a critical evaluation of various aspects such as the tolerable injury level of the plant, the value of the crop, nature of the pest damage and cost involved, etc, are to be considered. The scope of the biological control of the pest is discussed.

3163 Mathew, G; Ali, M.I.M. 1987. **Microbial pathogens causing mortality in the carpenterworm, *Cossus cadambae* Moore (Lepidoptera, Cossidae), a pest of teak (*Tectona grandis* Linn.f.) in Kerala (India)**. Journal of Tropical Forestry 3(4): 349-351.

Six species of pathogenic organisms were isolated and identified from field and laboratory specimens of C. cadambae: Aspergillus flavus, Paecilomyces fumosoroseus, Serratia marcescens, Pseudomonas sp., Penicillium citrinum and Fusarium solani.

3164 Mathur, R.N. 1977. **Integrated pest control in forestry**. Indian Forester 103(9): 585-591.

The importance is emphasized of knowing the ecology and dynamics of insect populations before undertaking control measures. Insect attack on important Indian tree species, e.g. the defoliators, *Hapalia machaeralis* and *Hyblaea puera* on teak, are used to illustrate the integrated use of silvicultural, biological and chemical control methods.

3165 Meshram, P.B; Bisaria, A.K; Kalia, S. 1997. **Efficacy of Bioasp and Biolep - a microbial insecticide against teak skeletonizer, *Eutec-***

***tona machaeralis* Walk**. Indian Forester 123(12): 1202-1204.

Two commercial formulations, viz. Bioasp and Biolep of *Bacillus thuringiensis* var. *kurstaki* were tested against *E. machaeralis*. All treatments gave significantly better larval mortality than the control. Bioasp 2 percent was most effective giving 85.9 percent mortality followed by Biolep.

3166 Misra, R.M. 1975. **Note on *Anthia sexguttata* Fabricius (Carabidae: Coleoptera), a new predator of *Pyrausta machaeralis* Walker and *Hyblaea puera* Cramer**. Indian Forester 101(10): p605.

During a survey of the natural enemies of defoliating pests in teak plantations adults of the carabid *Anthia sexguttata* were observed preying on fourth-instar larvae of *Pyrausta machaeralis*. The prey-capturing and feeding habits of *A. sexguttata* are described.

3167 Mohanadas, K. 1996. **New records of some natural enemies of the teak defoliator, *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidae) from Kerala, India**. Entomon 21(3/4): 251-253.

Six species of hymenopteran parasitoids, Camptotypus arianus, Xanthopimpla sp., Theronia maskeliyae, Psilochalcis carinigena, Brachymeria lugubris and Tetrastichus howardi and 4 species of reduviid predators, Euagoras plagiatus, Endochus sp., Rhenocoris fuscipes and Sphedanolestus aterrimus were recorded for the first time from Hyblaea puera.

3168 Nair, K.S.S. 1998. **KFRI's tryst with the teak defoliator**. Evergreen 40: 1-7. Kerala Forest Research Institute, Peechi.

A short report is given of research at the Kerala Forest Research Institute on the teak defoliator, *Hyblaea puera*. The report covers the impact of defoliation on volume increment, population dynamics, the search for resistant trees, an artificial diet for mass rearing, a solar light trap for population monitoring, and biological control using parasites, baculovirus and commercial formulations of *Bacillus thuringiensis*. Future prospects for control are briefly discussed.

3169 Nair, K.S.S; Babjan, B; Sajeev, T.V; Sudheendrakumar, V.V; Ali, M.I.M; Varma, R.V; Mohanadas, K. 1996. **Field efficacy of nuclear polyhedrosis virus for protection of teak against the defoliator, *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidae)**. Journal of Biological Control 10(1/2): 79-85.

A teak plantation at Nilambur, Kerala, was protected from *Hyblaea puera* using a naturally occurring baculovirus. A single foliar application of a crude preparation of HpNPV at the rate of 1 X 105 PIBs ml-1 of spray fluid at the earliest sign of each infestation gave a 70-76 percent level of control. In protected trees, the basal area increment was enhanced by 41 percent, indicating the efficacy of HpNPV as a biocontrol agent.

3170 Nair, K.S.S; Mohanadas, K; Sudheendrakumar, V.V. 1997. **Biological control of the teak defoliator, *Hyblaea puera* Cramer (Lepidoptera, Hyblaeidae) using insect parasitoids - problems and prospects**. Biological Control of Social Forest and Plantation Crop Insect: 75-95. T.N. Ananthakrishnan, Ed. Oxford and IBH, New Delhi.

Information on the parasitoids of *H. puera* in India are summarized and based on original data on pest and parasitoid populations and their dynamics in teak plantations at Nilambur, Kerala, the potential of each group of parasitoids for biological control is evaluated. It is shown that well timed inundative release of selected parasitoids control the pest.

3171 Nair, K.S.S; Sudheendrakumar, V.V; Mohanadas, K; Varma, R.V. 1997. **Control of the teak defoliator - past attempts and the new promise**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 81-83. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

This paper summarises past attempts for the control, evaluates the accomplishments and constraints and contemplates on future prospects.

3172 Nair, K.S.S; Varma, R.V; Sudheendrakumar, V.V; Mohanadas, K; Ali, M.I.M. 1998. **Management of the teak defoliator (*Hyblaea puera*) using nuclear polyhedrosis virus (NPV)**. KFRI Research Report 151: 64p. Kerala Forest Research Institute, Peechi.

Evaluated the usefulness of a naturally occurring nuclear polyhedrosis virus of the teak defoliator, *Hyblaea puera* and developed suitable field application methods. A unique mass production method was developed for HpNPV, which made use of the availability of large numbers of larvae during natural pest outbreaks in teak plantations. Laboratory methods of HpNPV production were also developed using artificially reared larvae. Methods were standardized for timely application of HpNPV using a pest monitoring system involving moth catches with a solar powered light trap.

3173 Nair, K.S.S; Varma, R.V; Sudheendrakumar, V.V; Mohandas, K; Sajeev, T.V. 2001. **Use of baculovirus control agents within an integrated pest management strategy against teak defoliator, *Hyblaea puera*, in India**. KFRI Research Report 203: 51p. Kerala Forest Research Institute, Peechi.

The study was to use the *Hyblaea puera* nuclear polyhedrosis virus economically and effectively for controlling the teak defoliator. The optimal use of the virus was examined considering various parameters. The information quantified included aspects of virus-host interaction, virus production methods, virus yield and the effect of environmental factors like ultra violet light and rainfall on virus persistence. The efficiency of different spraying systems was also evaluated based on the quantified information on droplet emission and field capture rates. The study revealed the scope of using HpNPV in the most efficient way against *H. puera*, by considering various parameters with the Control Window concept.

3174 Patil, B.V; Thontadarya, T.S. 1983. **Natural enemy complex of the teak skeletonizer, *Pyrausta machaeralis* Walker (Lepidoptera: Pyralidae) in Karnataka**. Entomon 8(3): 249-255.

A survey conducted in forests in Karnataka on the natural enemies of the teak pest, *Pyrausta machaeralis* revealed the presence of 43 species of parasites, 60 species of predators, 3 species of pathogens and 8 species of hyperparasites.

3175 Patil, B.V; Thontadarya, T.S. 1983. **Studies on the acceptance and biology of different *Trichogramma* spp. on the teak skeletonizer, *Pyrausta machaeralis* Walker**. Indian Forester 109(5): 292-297.

All 10 species of *Trichogramma* parasites tested in the laboratory successfully completed their development in eggs of P. machaeralis.

3176 Patil, B.V; Thontadarya, T.S. 1984. **Efficacy of egg parasite, *Trichogramma* spp. in parasitising the eggs of the teak skeletonizer, *Pyrausta machaeralis* Walker (Lepidoptera: Pyralidae)**. Indian Forester 110(4): 413-418.

Three species of exotic parasites, *Trichogramma* were released in a moderately infested 3-yr-old teak plantation to study their possible establishment and survival capacity in parasitizing the eggs of P. machaeralis. Recoveries of parasitized eggs were quite high after two and seven days of release in all three species. The study indicated the possibility of success if the three *Trichogramma* species were released in large numbers.

3177 Patil, B.V; Thontadarya, T.S. 1986. **Diapause in teak skeletonizer, *Pyrausta machaeralis* and its parasite, *Cremnops atricornis***. Mysore Journal of Agricultural Sciences 20(1): 38-42.

The diapaused larvae of *E. machaeralis* were parasitized by the braconid *Cremnops atricornis* which underwent larval diapause in synchrony with the host.

3178 Patil, S.U; Naik, M.I. 1997. **Evaluation of *Trichogramma* chilonis Ishii-An egg parasitoid against teak defoliator, *Hyblaea puera* Cramer**. Indian Journal of Forestry 20(2): 183-186.

Parasitoids, *Trichogramma chilonis* were released at different dosages into 10-yr-old teak plantations infested by *Hyblaea puera*. Significant variations in the egg populations and in the larval population were found among treatments, and a high percentage of parasitism was found both in eggs and larvae of *H. puera*. Parasitization increased, and larval populations of *H. puera* decreased as the dosage of *T. chilonis* per acre was increased.

3179 Patil, S.U; Naik, M.I. 1998. **Natural enemies of teak defoliator, *Hyblaea puera* Cramer and their seasonal incidence**. Indian Journal of Forestry 21(3): 253-255.

Surveys were made of natural enemies of *Hyblaea puera* during the period of the pest's activity in teak plantations. Some 11 larval parasitoids and 4 predators of *H. puera* were identified. *Elachertus nigrithorax*, *Eriborus* sp. and *Nitala* sp. were recorded for the first time on *H. puera*. The parasitoids *Palexorista solennis, Eriborus* sp., *Apanteles* sp., *Goniozus* sp., *Mesochorus* sp. and *Elachertus nigrithorax* were more efficient at suppressing the population of *H. puera* in the teak plantations.

3180 Pillai, S.R.M; Gopi, K.C. 1996. **Stem gall of teak and its management**. Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium, Peechi, 23-26

November 1993: 427-430. K.S.S. Nair; J.K. Sharma; R.V. Varma, Eds. Kerala Forest Research Institute, Peechi.

Occurrence of gall midge, *Asphondylia tectonae*, attack in the South Indian teak growing region is explored. Possible damage inflicted is discussed with special reference to a new parasitoid *Syntomernus* sp. as a biological control agent.

3181 Rabindra, R.J; Varma, R.V; Ali, M.I.M; Sudheendrakumar, V.V. 1997. **Tests for cross-infectivity of the nuclear polyhedrosis virus of the teak defoliator, *Hyblaea puera* to some lepidopterous insects**. Pest Management in Horticultural Ecosystems 3(2): 109-111.

Studies with the nuclear polyhedrosis virus of *Hyblaea puera* showed that it was not cross-infective to larvae of *Helicoverpa armigera, Spodoptera litura* or *Amsacta albistriga*.

3182 Sajeev, T.V; Nair, K.S.S; Varma, R.V; Sudheendrakumar, V.V; Ali, M.I.M; Mohanadas, K. 2001. **Use of nuclear polyhedrosis virus against the teak defoliator, *Hyblaea puera*: Problems and prospects**. Microbials in Insect Pest Management: 149-153. Scientific Publishers, USA.

3183 Sakchoowong, W. 2002 . **Effects of entomopathogenic fungi on teak defoliator, *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidae) in laboratory**. Proceedings of the IUFRO FAO Workshop on Pest Management in Tropical Forest Plantations, Chanthaburi, Thailand, 25-29 May 1998. C. Hutacharen; B. Napompeth; G. Allard; F.R. Wylie, Eds. FORSPA Publication 30: 105-110. FAO Regional Office for Asia and the Pacific, Bangkok.

Studies on the effects of entomopathogenic fungi, *Beauveria bassiana* and *Metarhizium anisopliae* on *Hyblaea puera* was carried out in the laboratory to test their virulence and comparative efficiency for control. The results showed that both B. bassiana and *M. anisopliae* were pathogenic to the *H. puera* larvae.

3184 Sandhu, S.S; Rajak, R.C; Agarwal, G.P. 1993 . **Microbial control agents of forest pests at Jabalpur**. Annals of Forestry 1(2): 136-140.

Periodical surveys of infected, mummified and colonized insect larvae on forest trees have resulted in the isolation of various entomopathogenic microorganisms. Seven fungi, one bacterium, one unidentified virus and one nematode were isolated from larvae of forest insect pests. Their pathogenicity was evaluated under laboratory conditions.

3185 Sankaran, K.V; Mohanadas, K; Ali, M.I.M. 1989. ***Beauveria bassiana* (Bals.) Vuill., a possible biocontrol agent against *Myllocerus viridanus* Fabr. and *Calopepla leayana* Latreille in South India**. Current Science 58(8): 467-469.

The fungal pathogen *Beauveria bassiana* is reported causing mortality in the chrysomelid, *Myllocerus viridanus* on teak in Kerala. In the laboratory, sprays containing spores applied caused 53 and 43 percent mortality.

3186 Sivaramakrishnan, V.R. 1976. **Occurrence of Lantana lace bug, *Teleonemia scrupulosa* Stal (Hemiptera: Tingidae) in South India**. Indian Forester 102(9): 620-621.

T. scrupulosa introduced into India from Australia and has been found infesting *Lantana* spp. The bugs feed on the leaves, inflorescence and fruits of Lantana spp. causing a burnt appearance. It is suggested that *T. scrupulosa* be used to suppress growth of the weed in sandal forests where no teak is grown.

3187 Sudheendrakumar, V.V. 1985. **Studies on the parasites of *Hyblaea puera* in teak plantations at Nilambur**. Advances in Biological Control in India. Proceedings of the National Seminar on Entomology, Calicut: 116-122. K.J. Joseph; U.C. Abdurahiman, Eds. University of Calicut.

Five species of parasites of *Hyblaea puera* namely, *Palexorista solennis, Brachymeria lasus, Sympiesis* sp. and two species of unidentified ichneumonid wasps were recorded. Among these parasites *Sympiesis* sp. is a new record on *H. puera*.

3188 Sudheendrakumar, V.V. 1993. **Notes on hymenopteran parasites of *Eutectona machaeralis* recorded from Nilambur, Kerala**. Indian Forester 119(6): 510-511.

Brief descriptions are given of 6 species of parasitoids of *Eutectona machaeralis* recorded in teak plantations. The parasites were *Trathala hapaliae*, *Gotra* sp. and *Stictopistus* sp., *Apanteles ruidis*, *Phanerotoma hendecasiella* and *Brachymeria hime attevae*.

3189 Sudheendrakumar, V.V. 1997. **Evaluation of parasitoids for biological control of the teak defoliator**. KFRI Research Report 129: 32p. Kerala Forest Research Institute, Peechi.

The biology, behaviour and mass multiplication of two species of indigenous parasitoids of the teak defoliator, *Hyblaea puera* namely, *Sympiesis hyblaeae* and *Palexorista solennis* were studied and the usefulness of these parasitoids as candidates for the biological control programme was evaluated based on their biological characteristics.

3190 Sudheendrakumar, V.V; Evans, H.F; Varma, R.V; Sajeev, T.V; Mohanadas, K; Sathyakumar, K.V. 2001. **Management of the teak defoliator, *Hyblaea puera* using baculovirus within a control window concept**. Tropical Forestry Research: Challenges in the New Millennium. Proceedings of the International Symposium, Peechi, India, 2-4 August 2000. R.V. Varma; K.V. Bhat; E.M. Muralidharan; J.K. Sharma, Eds: 106-114. Kerala Forest Research Institute, Peechi.

The paper deals with a comprehensive approach for using HpNPV for the management of the teak defoliator. The pest management, based on the Control Window concept, concentrates on five primary variables, the host, *Hyblaea puera*, the virus, environmental factors, the host tree, teak and spray technology. Under virus biology, dosage-mortality relationship between the virus and host and effect of environmental factors such as ultraviolet light, rain, etc., on virus persistence were studied.

3191 Sudheendrakumar, V.V; Sajeev, T.V; Varma, R.V. 2001. **Teak defoliator management by controlling epicentre populations - a case study**. KFRI Research Report 219: 31p. Kerala Forest Research Institute, Peechi.

A study was carried out to test the impact of controlling epicentre populations of the teak defoliator, *Hyblaea puera* on further large scale outbreaks. Sixteen epicentre patches area were detected between late February and late March and successfully controlled.

3192 Sudheendrakumar, V.V. 2002. **Bioecology of *Sympiesis hyblaeae* Surekha (Hymenoptera: Eulophidae) a parasitoid of the teak defoliator, *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidae)**. Journal of Biological Control 16(2): 97-101.

The biology, behviour and seasonal dynamics of *Sympiesis hyblaeae* an ectoparasitoid of the teak defoliator, *Hyblaea puera* are discussed. Pupae are observed going through a diapause period ranging from 111-156 days. The seasonal incidence pattern indicates that *S. hyblaeae* is not a potential natural biocontrol agent of the teak defoliator.

3193 Sudheendrakumar, V.V. 2002 . **Feasibility of using indigenous parasitoids for biological control of the teak defoliator, *Hyblaea puera* (Lepidoptera: Hyblaeidae)**. Proceedings of the IUFRO FAO Workshop on Pest Management in Tropical Forest Plantations, Chanthaburi, Thailand, 25-29 May 1998. C. Hutacharen; B. Napompeth; G. Allard; F.R. Wylie, Eds. FORSPA Publication 30: 111-121. FAO Regional Office for Asia and the Pacific, Bangkok.

This paper deals with the scope and limitations of using indigenous parasitoids for practical biological control of *Hyblaea puera*. The potential of two larval parasitoids, *Sympiesis hyblaeae* and *Palexorista solennis* were studied and evaluated based on their biological and behavioural characteristics and the feasibility of mass multiplication. The study revealed that mass multiplication of *P. solennis* is feasible under laboratory condition as per standard methods.

3194 Surekha, K; LaSalle, J; Sudheendrakumar, V.V; Murphy, S.T. 1996. **A new species of *Sympiesis* (Hymenoptera: Eulophidae) parasitic on the teak defoliator *Hyblaea puera* (Lepidoptera: Hyblaeidae) in India**. Bulletin of Entomological Research 86(1): 73-76.

Sympiesis hyblaeae, which is a solitary endoparasitoid of first- and second-instar larvae, is a potential biological control agent of the teak defoliator, *Hyblaea puera*.

3195 Tilakaratna, D. 1991. **Parasites of the teak defoliator, *Hyblaea puera***. Sri Lanka Forester 20(1/2): 23-25.

This paper gives brief accounts of three species of insect parasites which may be useful for the control of teak defoliators. They are *Brachymeria euploeae, Echthromorpha notularia* and *Carcelia kockiana*.

3196 Wiwatwitaya, D. 1996. **Predator ants of teak beehole borer, *Xyleutes ceramicus* Walker (Lepidoptera: Cossidae)**. (Thai). Kasetsart Journal, Natural Sciences 30(3): 330-335.

The study on predator ants of teak beehole borer, *Xyleutes ceramicus* was carried out with the purpose to investigate the quantity and kind of predatory ant species preying on the borer. *Crematogaster* spp. and *A. longipes* were mostly dominant predators on the borer.

3197 Zacharias, V.J; Mohanadas, K. 1990. **Bird predators of the teak defoliator *Hyblaea puera***. Indian Journal of Forestry 13(2): 122-127.

Out of 58 species of birds observed in the older plantation, 48 were feeding on *Hyblaea puera*. In the younger plantation 44 bird species were observed and 41 were feeding on *H. puera*. Data are tabulated of birds seen feeding on larvae, or observed feeding on larvae throughout the observation periods and birds suspected to feed on pupae.

Go top

Chemical Control

3198 Bandara, G.D. 1990. **Chemical control of cockchafer grub (Holotrichia serrata) in teak nurseries**. Sri Lanka Forester 19(3/4): 47-50.

The damage caused by the cockchafer grub, larvae of *Holotrichia serrata* in nurseries is one of the main problems in raising teak plantations. In this study three insecticides, carbofuran, diazinon, and benfuracarb, were tested against the pest and carbofuran is found to be the best insecticide for controlling this pest.

3199 Borse, S.S; Thakur, M.L. 1993. **Relative toxicity of some synthetic pyrethroids against teak skeletonizer, *Eutectona machaeralis* (Walk.) (Lepidoptera: Pyralidae)**. Indian Journal of Forestry 16(3): 193-195.

The results are presented of laboratory experiments with commercial formulations of three commonly available pyrethroid insecticides tested against third instar larvae of the teak skeletonizer, *Eutectona machaeralis*.

3200 Borse, S.S; Thakur, M.L. 1994. **Residual toxicity of some commercial synthetic pyrethroids to *Eutectona machaeralis* (Walk.) (Lepidoptera: Pyralidae)**. Indian Journal of Forestry 17(1): 49-52.

Cypermethrin, deltamethrin and fenvalerate were evaluated for their residual toxicity against the teak skeletonizer, *E. machaeralis* under laboratory conditions using sprayed potted 1-month-old seedlings of teak. Cypermethrin showed significantly higher residual toxicity to *E. machaeralis* than those of deltamethrin and fenvalerate.

3201 Choudhury, J.C.B. 1971. **Interim report on the Konni aerial spraying project**. Working Plan for Nilambur Forest Division, 1967-68 to 1976-77: 165-168: K.G. Vasudevan, Ed. Government of Kerala.

3202 David, B.V; Manickavasagam, S. 1996. **Use of chitin inhibitor, diflubenzuron in forest insect pest management**. Impact of diseases and insect pests in tropical forests. Proceedings of the IUFRO Symposium, Peechi, India, 23-26 November 1993: 382-383. K.S.S. Nair; J.K. Sharma; R.V. Varma, Eds. Kerala Forest Research Institute, Peechi, India.

Environment friendly pesticides like the chitin synthesis inhibitor, diflubenzuron, are ideal for forest pest management. Results of studies indicate that diflubenzuron is effective against the lepidopteran defoliators of teak, poplar and chir pine.

3203 Eungwijarnpanya, S; Yincharoen, S. 2002. **Control of teak defoliator, *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidae), by thermal fogger application of neem extract**. Proceedings of the IUFRO FAO Workshop on Pest Management in Tropical Forest Plantations, Chanthaburi, Thailand, 25-29 May 1998. C. Hutacharen; B. Napompeth; G. Allard; F.R. Wylie, Eds. FORSPA Publication 30: 123-125. FAO Regional Office for Asia and the Pacific, Bangkok.

Neem extract containing 0.185 percent azadirachtin was tested at three concentrations diluted in 5 litres of water applied to a teak plantation in Lampang province, Thailand to test for control of *Hyblaea puera*.

3204 Gu, M.B. 1982. **A discussion on the problem of controlling *Pyrausta machaeralis***. Acta Entomologica Sinica 25(1): p8.

The author discusses the problems encountered in the insecticidal control of *Eutectona machaeralis* on *Tectona grandis* in China.

3205 Gupta, B.K; Borse, S.S. 1997. **Relative toxicity of some insecticides as contact poison against third instar larvae of *Hyblaea puera* (Lepidoptera: Hyblaeidae)**. Indian Forester 123(5): 427-429.

Eleven insecticides were bioassayed against third instar larvae of *Hyblaea puera* under laboratory conditions. Their relative toxicity was assessed.

3206 Gupta, B.K; Sen Sarma, P.K. 1978. **Antitermite properties of some anthraquinone derivatives**. Holzforschung und Holzverwertung 30(3): 57-58.

During laboratory tests 6 anthraquinone derivatives were tested against

Neotermes bosei and *Microcerotermes beesoni*. Of the 6 derivatives, chrysophanol proved most resistant to the termites.

3207 Intari, S.E; Amir, M. 1975. **Observations on attack by *Neotermes tectonae* on teak in Mantingan forest district, central Java, and a trial of chemical control with Phostoxine**. Laporan, Lembaga Penelitian Hutan 198: 18p.

Describes the damage caused by this pest and discusses its control and the influence of stand age and microclimate. Chemical control was tried on *Tectona grandis* by introducing a fumigant tablet through a small hole drilled in the stem.

3208 Mathew, G. 1993. **Injection and implantation of some systematic insecticides for the control of the teak carpenterworm, *Alcterogystia cadambae* (Moore) (Lepidoptera: Cossidae)**. Journal of Tropical Forestry 9(2): 148-151.

The effectiveness of bole injected chemicals for the control of the teak carpenter worm, *Alcterogystia cadambae* was field tested. High dosages of dimethoate, phosphamidon, monocrotophos and acephate were used in the trials.

3209 Meshram, P.B. 1995. **Evaluation of some medicinal and natural plant extracts against teak skeletonizer, *Eutectona machaeralis* Walk**. Indian Forester 121(6): 528-532.

Crude extract of fresh leaves of 32 different medicinal and other woody plants were tested under laboratory against third instar larvae of the teak skeletonizer, *Eutectona machaeralis* to evaluate their antifeedant and insecticidal effects.

3210 Meshram, P.B; Joshi, K.C; Sarkar, A.K. 1993. **Efficacy of some insecticides against the white grub, *Holotrichia insularis* Brenske in teak nursery**. Annals of Forestry 1(2): 196-198.

Six insecticides, phorate, aldrin and Folidal were tested for their effects on white grub populations and grub damage of teak seedlings in a nursery in Maharashtra.

3211 Meshram, P.B; Kulkarni, N; Joshi, K.C. 1994. **Antifeedant activity of certain plant products against teak skeletonizer, *Eutectona machaeralis* Walk. (Lepidoptera: Pyralidae)**. Annals of Entomology 12(2): 53-56.

Extracts of *Azadirachta indica*, *Aloe vera*, *Jatropha curcas*, *Calotropis procera*, *Annona squamosa* and *Vitex negundo* were tested for their antifeedant properties against third-instar larvae of *Eutectona machaeralis* in the laboratory.

3212 Meshram, P.B; Pathak, S.C; Jamaluddin. 1990. **Effect of some soil insecticides in controlling the major insect pests in teak nursery**. Indian Forester 116(3): 206-213.

The results are reported of a field experiment in the teak nursery in Madhya Pradesh on control of the three major nursery pests of the species: white root grubs, teak defoliator and teak skeletonizer. insecticides were applied on seed beds and at the seedling stage. Carbaryl and HCH were found the most effective treatments against these pests.

3213 Muttiah, S. 1967. **An insecticide trial for the control of cockchafer larvae (*Anomala* sp.) in teak nurseries**. Ceylon Forester 8(1/20): 12-19.

Experiments in spraying teak seed beds after germination with Sevin, Gammexane, Endrex and Aldrex 2, to control damage by chafer grubs, indicated the significant superiority of Sevin.

3214 Nair, K.S.S. 1986. **The problem of insect defoliation of teak - to spray or not to spray**. Proceedings of the 2nd Forestry Conference Vol.2: 876-879. Forest Research Institute and Colleges, Dehra Dun.

A critical review of past attempts to estimate loss of wood increment due to defoliation shows that no reliable estimate is available. A realistic appraisal of the damage in economic terms is essential before attempting control measures. The need for detailed investigations on the nature and cause of fluctuations in the populations of the defoliator complex is stressed to decide on the best pest management strategy.

3215 Nair, K.S.S. 1987. **Control of the sapling borer, *Sahyadrassus malabaricus* (Lepidoptera, Hepialidae) in forest plantations**. Entomon 12(2): 137-139.

Five insecticides were tested for the control of larvae of *Sahyadrassus malabaricus* in plantations of teak and *Trema orientalis* in Kerala. HCH, lindane, carbaryl, Sevimol and tar concentrate did not give complete protection. Quinalphos gave complete control.

3216 Neelay, V.R; Bhandari, R.S; Negi, K.S. 1983. **Effect of insecticidal and hormonal spray on the production of fruits in teak seed orchard**. Indian Forester 109(11): 829-839.

The problem of poor seed setting in a seed orchard in Maharashtra was investigated. Major insect pests causing fruit loss are Pagyda salvalis, Leptocentrus vicarius, *Dichocrocis punctiferalis*, *Hyblaea puera* and *Eutectona machaeralis*. Insecticides were applied as a spray with the hormone NAA and without the hormone. Data shows that the best results were with nuvacron or endosulfan both as water emulsions with 40 p.p.m. NAA.

3217 Patil, A.K; Patil, B.R; Patil, A.P; Patil, P.T. 1995. **Efficacy of insecticides against the teak defoliator *Hyblaea puera* Cramer (Lepidoptera: Hyblacidae)**. Indian Journal of Forestry 18(4): 290-292.

A field trial was laid out to test the efficacy of seven insecticides, viz. cypermethrin, fenvalerate, monocrotophos, acephate, endosulfan, quinalphos and carbaryl, against this pest. Cypermethrin, fenvalerate and acephate were found highly effective.

3218 Perez, G.C.M. 1947. **Insecticidal value of *Tephrosia noctiflora* and *T. cinerea***. (Spanish). Revista de la Facultad de Ciencias Cuimicas, Universidad Nacional de la Plata 22, 1947: 239-266.

3219 Remadevi, O.K; Muthukrishnan, R. 1998. **Farmer trials on the control of the defoliators, *Eutectona machaeralis* Walker and *Hyblaea puera* Cramer on teak saplings**. Advances in IPM for horticultural crops. Proceedings of the First National Symposium on Pest Management in Horticultural Crops: Environmental implications and thrusts, Bangalore, 15-17 October 1997: 179-182. P.P. Reddy; N.K.K. Kumar; A. Verghese, Eds. Association for Advancement of Pest Management in Horticultural Ecosystems, Indian Institute of Horticultural Research, Bangalore.

A field study in Karnataka revealed that 0.1 percent of monocrotophos was best for immediate control of the pests followed by chlorpyrifos and quinalphos.

3220 Sandermann, W; Schmidt, H. 1973. **The effectiveness of some organic compounds against the soil termite *Reticulitermes flavipes* (Kollar)**. (German). Holz als Roh- und Werkstoff 31(2): 71-73.

The mortality rate of termites in the presence of filter paper soaked in solutions of 16 organic compounds was determined. The results showed that the action of tectoquinone is not specifically related to the structure of organic compounds, but that other compounds with a similar skeleton are more effective.

3221 Senguttuvan, T; Chinniah, C; Varma, R.V; Nair, K.S.S. 2000. **Knockdown toxicity of insecticides and B.T formulations on larvae of teak defoliator, *Hyblaea puera***. Indian Journal of Forestry 23(2): 160-163.

Laboratory experiments were conducted to assess the knockdown toxicity of six insecticides against third and fourth instar larvae of the teak defoliator, *Hyblaea puera*. All the insecticides were highly effective against both third and fourth instar larvae under controlled conditions after 24 h of feeding. The *B. thuringiensis* formulations were effective even at lower concentrations against third instar and at higher concentrations against fourth instar larvae.

3222 Singh, P. 1980. **Aerial spraying of chemicals to control teak defoliators**. Proceedings of the 2nd Forestry Conference Vol.2: 901-907. Forest Research Institute and Colleges, Dehra Dun, India.

3223 Singh, P; Gupta, B.K. 1978. **Laboratory evaluations of insecticides as contact sprays against forest pests. I. Teak skeletoniser: *Pyrausta machaeralis* Walker (Lepidoptera: Pyralidae)**. Indian Forester 104(5): 359-366.

Out of twenty insecticides tested, with 3rd-instar larvae, monocrotophos, chlordimeform, quinalphos and Anthio were found the most effective.

3224 Vaishampayan, S.M; Bhandari, R.S. 1980. **Chemical control of white grubs (*Holotrichia insularis*) in teak nurseries**. Proceedings of the 2nd Forest Conference, Vol.2: 868-872.

3225 Vivekanandan, K. 1975. **Control of cockchafer grub in teak nursery**. Sri Lanka Forester 12(1): 40-43.

Of five insecticides applied fensulfothion granules at the rate of 1.5 lb/160 ft2 gave the most effective control of the larvae of *Holotrichia serrata*.

3226 Wolcott, G.N. 1947. **Termite repellents: A summary of laboratory tests**. Bulletin of Argricultural Experiment station 73. University of Puerto Rico.

3227 Wolcott, G.N. 1954. **Termite damage and control as factors in the utilization of timber in the Caribbean area**. Journal of Agriculture of the University of Puerto Rico 38(2): 115-122.

Biology and destructive ability of *Nasutitermes costalis*, *Heterotermes tenuis* and *Cryptotermes brevis* is studied and out of which the first causes much less economic damage. Chlordane, aldrin and dieldrin are found very efficient in killing the termites and impregnation of susceptible woods with pentachlorophenol or its Na salt prevents attack.

3228 Wolcott, G.N. 1955. **Termite repellents: A summary of laboratory tests**. Journal Agricultural University, Puerto Rico 39: p115.

Go top

Surveying and Mapping

3229 **Report of the result of forest inventory work carried out in N. Thailand**. (Siamese). Vanasarn 16(1), 1958: 16-22.

Results are presented of forest inventory carried out in N. Thailand in 1956.

3230 **Areas of teak plantations in Africa**. Unasylva 21(3/4), 1967.

3231 **Forest plantations in Latin America: Their development and prospects**. Revue forestal venezolona 11(16), 1968: 5-47.

A review give information on the areas of plantations of different species which include teak established since 1965, age, distribution of plantations and the mean area planted annually from 1961 to 1965, and future planting programmes.

3232 Bhatia, K.K. 1954. **Factors in the distribution of teak (*Tectona grandis* Linn.f.) and a survey of teak forests of Madhya Pradesh**. Thesis. Saugar University.

3233 FAO. 2000. **Global forest resources assessment - main report**. FAO Forestry Paper 140. FAO, Rome.

3234 Ferguson, J.H.A. 1933. **Alignment chart to find the number of trees out of the upper height and the degree of thinning**. (Dutch; English). Tectona 26: 763-771.

The article described the general use of alignment chart with appended charts. For any given upper height and mean mutual distance of trees of the upper height, the number of trees per hectare can be read from these charts. By means of a second alignment chart the number of trees per hectare can be reduced to the number of trees in any area.

3235 Forest Department, Trinidad and Tobago. 1988. **Our plantation resource: an inventory of forest plantations in Trinidad**. 89p. Forestry Division, Port of Trinidad and Tobago, Spain.

Tables show the area, relative density, height and stocking of *Tectona grandis* and *Pinus caribaea* plantations in Trinidad and Tobago.

3236 Hamzah, Z. 1975. **Report on a survey of the area of *Tectona grandis* in the province of SE Celebes, forest districts of Kendari, Muna and Buton**. (Indonesian). Laporan, Lembaga Penelitian Hutan 201: 173p.

Many historical references and local traditions concerning the natural stands are reviewed in support of the view that teak is not indigenous to Celebes but was introduced by Hindu migrants from Java. The current neglect of forest management in many areas is emphasized and the drafting of a working plan for the whole province is recommended, especially to safeguard the teak areas.

3237 Hamzah, Z. 1975. **Report on a survey of the area of *Tectona grandis* in the province of Western Lesser Sunda Is., forest district of Lombok**. (Indonesian). Laporan, Lembaga Penelitian Hutan 200: 70p.

This report gives an account of the forests and forestry, geography, soils, etc. as well as tabulated inventories of teak plantations. The properties of wood are equivalent to those of Java teak. It is recommended that secondary forest in the Pelangan peninsula should be converted to teak plantations.

3238 Hamzah, Z. 1975. **Report on a survey of the area of *Tectona grandis* in the province of West Sumatra**. (Indonesian). Laporan, Lembaga Penelitian Hutan 203: 163p.

A detailed account of forestry and forest administration as well as the vegetation, soils, and political geography of this province of Indonesia is given. The local provenance of *T. grandis* appears to be a distinct ecotype selected from stock introduced from Java during the Hindu period. It is reported that *T. grandis* is well adapted to local conditions.

3239 Hollerwoger, F. 1957. **Compilations of information on methods used for inventory of teak forests with the aid of aerial survey**. FAO Teak Sub-Commission, Bandung FAO/TSC-57/9: 6p. FAO, Rome.

Determination of stand volumes directly from aerial photos has only just begun and has most promise for plantations.

3240 Kachhwaha, T.S. 1983. **Spectral signatures obtained from Landsat digital data for forest vegetation and land-use mapping in India**. Photogrammetric Engineering and Remote Sensing 49(5): 685-689.

Spectral signatures were used to delineate 11 land cover classes including forest areas of *Tectona grandis*.

3241 Karnataka Forest Department. 1977. **Forest wealth in Karnataka - resources survey data**. Myforest 13(2): 99-121.

Tables are given showing the growing stock and diameter distribution of 11 species including *Tectona grandis* in 11 forest divisions of Karnataka.

3242 Loetsch, F. 1956. **Inventory methods for tropical forests**. FAO/EPTA Report 545. FAO, Rome.

Reports the methodology of the survey of tropical zone in Thailand and gives volume tables for teak plantation and figures on merchantable volume and distribution of diameter classes.

3243 Loetsch, F. 1956. **The Siamese teak survey of 1956/57**. (German). Holz Zentralblatt 83(110): 1331-1333.

Discusses methods and the results of a survey covering 61,000 sq.km. in North Thailand, including volume figures for important species. The dangers to sustained yield from illegal fellings and shifting cultivation are stressed.

3244 Loetsch, F. 1957. **A forest inventory in Thailand**. Unasylva 11(4): 174-180.

Describes a method developed for an inventory of the northern teak-bearing provinces of Thailand. Sampling was based on stratification worked out from aerial photos. Field-sampling and computation methods are described, and costs estimated.

3245 Loetsch, F. 1957. **The method used for the Thailand forest inventory of the northern teak bearing provinces**. FAO Teak Sub-Commission, Bandung FAO/TSC-57-8: 7p.

Describes the methods of inventory followed in the teak-bearing forests of Thailand with the aid of aerial photographs. The sampling design followed is the tract-line system described in detail. The field sampling methods and problems are explained and the data to be measured inside the sample plots by each crew is indicated. The punch card tally sheets to be used for data collection are explained, and the statistical methods of analysis of data and error calculations are also explained.

3246 Loetsch, F. 1958. **Report to the Government of Thailand on forest inventory of the northern teak bearing provinces. Expanded Technical Assistance Programme, FAO, Rome**. FAO Report 895: 58p.

Provided a historical review of teak management in Thailand, sampling for the inventory, forest types and their stock structure, percentage of individual forest types in relation to total area sampled, volume of standing timber and recommendations for future management of teak.

3247 Lynch, T.B; Rusydi, R. 1999. **Distance sampling for forest inventory in Indonesian teak plantations**. Forest Ecology and Management 113(2/3): 215-221.

Distance sampling techniques were compared with point sampling and fixed-radius circular plot sampling for inventory of teak plantations in East Java, Indonesia.

3248 Maslekar, A.R. 1977. **Aerial assessment of young teak plantations of Allapalli Range, Maharashtra**. Indian Forester 103(7): 486-489.

Large scale black and white aerial photographs were taken of 8 teak plantations 3-140 ha in area and all less than 3 yr old. Successful areas, areas of poor growth, totally failed areas and patches of dense weed growth could be distinguished.

3249 Mokashi, V.K. 1956. **Study of sampling techniques in enumerations in forest**. Indian Forester 82(4): 171-175.

Sampling technique and the sampling intensity for estimation of growing stock with a reasonable accuracy are in progress in Bombay State. Certain results arising out of these investigations on complete enumeration data for one compartment of Dangs division are discussed. It was seen that random line-plot survey gave more precise estimates than strip survey for the same intensity of sampling.

3250 Myint Tin; Kyaw Tint. 1968. **Experiments on sampling in forest inventory**. Union Burma Journal of Life Science 1(1): 46-49.

A comparison was made between line-plot sampling with circles of 10 ft. radius and 30 ft. radius, and strip sampling in N. Toungoo forest division. Reported that the field work was hard and tiresome and strip and line-plot methods are not recommended for rough and hilly forests of Burma.

3251 Myint Tin; Tha Tun San. 1968. **Forest inventory in Minbyin reserve**. Union Burma Journal of Life Science 1(1): 50-61.

Gives details of a stratified two-stage sampling applied to collect data on the growing stock of species including *Tectona grandis*. Stratification was done with the help of past data, aerial photos and maps. The method was reported to be satisfactory in terms of precision and feasibility for application in hilly areas, but was time-consuming for enumeration and computation of the estimates.

3252 Naco, M.F. 1989. **Development and application of a forest screenometer for forest inventory**. Gregorio Araneta University Foundation, Philippines: 75 leaves.

Surveying was made easy with the use of screenometer because of its unique characteristics, easy to handle, easy to construct and manipulate.

3253 Nokoe, S; Agbavwe, C. 1993. **Determining the optimum number of strata for sampling a normally distributed forest population**. Discovery and Innovation 5(4): 301-305.

The purpose of the study was to determine the optimum number of strata in a forest population when the underlying distribution is normal, and the variable for stratification is either the variable of interest or a linearly related auxiliary variable. The technique used in both cases involved the combination of the Neyman allocation of strata sample sizes, Dalenius and Hodges cumulative square root frequency method, and a simple cost function of the form suggested by Dalenius.

3254 Oza, M.P; Srivastava, V.K; Pariswad, B.S; Setty, K.R.V. 1989. **Relationship between Landsat MSS data and forest tree parameters**. International Journal of Remote Sensing 10(11): 1813-1819.

Band ratios, indices and radiance in the four channels of the multispectral scanner on the Landsat-4 satellite were correlated with mean tree parameters of teak plantations in the north Kanara region of Karnataka. Age, mean tree height, mean tree d.b.h., mean canopy diameter and mean canopy volume were measured.

3255 Rao, T.K; Rao, S.V.V.S; Murthy, V.K. 1985. **Indian forests - an overview**. Indian Forester 111(8): 571-578.

A review of India's forests and changes in the forest area during different periods of time from 1951-52 to 1977. Teak forests comprise 12 percent of the forests.

3256 Seth, S.K. 1957 . **Inventory methods in teak forests in India**. FAO Teak Sub-Commission, Bandung, 1957, FAO/TSC-57/17: 3p.

3257 Seth, V.K; Tomar, M.S. 1973. **Contribution of small scale photographs in forest resources survey of East-Godavari**. Indian Forester 99(2): 92-99.

Photo interpretation resulted in much greater precision in estimating area, cover type and land use and facilitated the rapid production of maps for the selection of sites suitable for teak and eucalypt plantations.

3258 Sithidisairak, P. 1966. **Photo interpretation by using panchromatic film with different kinds of filter on mixed deciduous teak forest**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Green and yellow filters show more details about tone, texture, size and shape of the teak crowns in the stand.

3259 Soetrisno, H. 1980. **Definite measure of teak forest in Java**. (Indonesian). Gema Rimba 6(51/52): 11-13.

3260 Srivastava, V.K; Oza, M.P. 1991. **Identification of teak (*Tectona grandis* Linn.f.) plantations using multitemporal Landsat MSS data**. Indian Forester 117(3): 178-186.

Multitemporal Landsat MSS digital data collected over the Yellapur Forest Division, Karnataka were used to select a proper season and month for the identification of teak plantations. The data sets collected in different years for the different months were corrected for discrimination of teak from other natural forest types in the area.

3261 Steenis, C.C.G van. 1958. **Vegetation map of Malaysia**. In collaboration with UNESCO, for the UNESCO Humid Tropics Research Project. Scale 1: 5,000,000.

A physiognomic map compiled from many sources, indicating 18 types of vegetation including teak forests.

3262 Suranggadjiwa, M.H. 1969. **Inventory of teak and other industrial wood species**. Rimba Indonesia 12(1): 37-46.

3263 Tiwari, K.P. 1977. **Volume stratification for stratified sampling through pilot survey with aerial photographs**. Indian Forester 103(9): 592-601.

A pilot survey was made of an area in E. Karimnager Forest Division, Andhra Pradesh, using aerial photographs on a 1:40 000 scale. The forested areas in the photographs were classified by height and crown closure and by species including teak.

3264 Troup, R.S. 1911. **A note on some statistical and other information regarding the teak forests of Burma**. Indian Forest Records 3(1). Forest Research Institute, Dehra Dun.

Distribution, area, forest types and growing stock and yield statistics, rate of growth, exploitable age, yield and outturn from teak forests of Burma are dealt with.

3265 Watcharakitti, S; Eadkeo, K; Thammincha, S. 1972. **Stereogram of mixed deciduous forest with teak**. (Thai). Faculty of Forestry, Kasetsart University, Thailand, Forest Research Bulletin 21: 42p.

The main part of the report is a series of paired aerial photographs 1 inch square at scale 1:20 000 or 1:25 000, accompanied by a pair of terrestrial stereo photographs and annotations of stand characteristics. Recognition characters on the aerial photographs are given for teak crowns and for mixed deciduous forest with *Tectona grandis*.

3266 Zwart, W. 1941. **The survey and mapping of the teak forest of Java and Madura, 13th February 1860 - 30th June 1871**. (Dutch). Tectona 34: 235-285.

A historical review is given of this survey, which was the first to be made in Java and Madura.

Go top

Growth and Yield

(See also 0053, 0105, 0169, 0236, 0246, 0276, 0330, 0417, 1900, 2236, 2289, 2352)

3267 **Rate of growth of teak in Magayi plantations, Burma**. Indian Forester 18, 1892: 218-221.

Gives growth rate of teak plantations of 1872-77 of 15 to 20 years age from Magayi, Burma.

3268 **The dimensions of trees**. Indian Forester 22(12), 1896: p465.

Size of teak from Yamethin forest used for building Buddhist monstery is given as length 64 ft., mean girth 13'9". Two giant teak trees located measured 20' in girth and height 60' to first branch and another one with girth 17'4" at 5' from g.1. standing.

3269 **Extraordinary irregularity in the growth of teak: What is the cause?** Indian Forester 23(8), 1897: 291-294.

Describes the growth cycles in teak in which an alternate cycles of normal and abnormal slow growth, again after 10-40 years growth becomes normal. Slow growth cycle is due to damage by insects, crowding and overshadowing due to fast grown trees and damage by fire.

3270 **A big teak log**. Indian Forester 24, 1898: 320-321.

Gives the measurements of an old log 82.5 x 10'; the butt girth is 12-13 feet and top girth 7-8 feet.

3271 **Production of teak timber in Burma**. Tectona 4, 1911: p438.

3272 **Teak timber production in Siam**. (Dutch). Korte Medecelingen, 1911: 244-248.

3273 **Rafting and measuring teak logs in the Sillang River, Burma**. Indian Forester 43(9), 1917: 389-397.

3274 **Rough volume tables for teak, Pyinkado**. Burma Forest Bulletin (Silviculture 11) 15, 1926.

Rough volume tables for teak is given.

3275 **Height growth of teak and cutting back after frost**. Forest Research in India, 1930: p18.

3276 **Diameter increment of teak in Burma**. Forest Research in India, 1932: p44.

3277 **Rate of growth of teak in Burma**. Forest Research in India, 1932: p42.

3278 **The largest teak tree ever to be extracted**. Timber Trade Journal, 1964 .

The oldest teak log of an immense tree, estimated to be 750 years old and probably the largest teak ever to be extracted. It was 232 ft. long and 19 ft. 10 in girth.

3279 Achaya, T; Bhadran, C.A.R. 1961. **Yield regulation in the Madras forests**. Indian Forester 87(2): 631-645.

Discusses the working plan prescriptions in each of the forest types occurring in Madras state, including moist deciduous forests with *Tectona grandis* as the principal species. Yield regulation in teak plantations has been dealt with separately.

3280 Ackhurst, P.W; Micski, J. 1971. **Tanzania standard volume table for teak**. 48p. Forest Division, Ministry of Natural Resources and Tourism, Tanzania.

Presents tables of total volume and of merchantable volume based on measurements of 903 trees from all major plantations of *Tectona grandis* in Tanzania.

3281 Adegbehin, J.O. 2002. **Growth and yields of *Tectona grandis* (Linn. F.) in the Guinea and derived Savanna of Northern Nigeria**. International Forestry Review 4(1): 66-76.

Trial plantings of exotic tree species commenced as early as 1930s in some parts of northern Nigeria. Site index curves and yield tables were constructed for *Tectona grandis*. The application of the growth figures in the management of the species is discussed.

3282 Ahmed, G.U. 1992. **Height, diameter and age relationships of *Tectona grandis* Linn.f., *Syzygium grande* Sheele and *Dipterocarpus turbinatus* Gaertn**. Chittagong University Studies, Science 16(2): 7-10.

Data on diameter at breast height and height were collected from 19-40 yr old plantations of Bangladesh. Regression analysis showed highly significant correlations between the variables. The results are discussed in the context of determining the rotation age of the species.

3283 Akindele, S.O. 1989. **Teak yields in the dry lowland rain forest area of Nigeria**. Journal of Tropical Forest Science 2(1): 32-36.

The yield of teak plantations established by taungya in the Gambari forest reserve, Nigeria was assessed. The study involved the examination of the stand volume-age relationship in sample plots established in five plantations.

3284 Ambasht, R.S; Singh, A.K; Misra, K.N. 1982. **Energy conserving efficiency and productivity of a gradient of communities in Chakia forest ecosystem**. Tropical forests: Source of energy through optimisation and diversification: 209-218. Penerbit Universiti Pertanian Malaysia, Serdang, Malaya.

Phytomass energy was measured in a gradient of ecosystems on the lower Vindhyan plateau near Varanasi. Data are tabulated for energy storage, net energy fixation and energy conservation efficiency by biomass components and layers of including teak plantation.

3285 Andersen, K.P. 1972. **Bamboo management an outline**. (English; Bengali). Bano Biggyan Patrika 4(2/3): 17-31.

Presents a brief economic analysis of the yield and production costs growing either bamboo or teak in the bamboo producing areas of reserved forests of the Eastern Circle of Bangladesh.

3286 Appelman, F.J. 1926. **The new yield tables for cultivated teak forests**. (Indonesian; English). Tectona 19: 1011-1019.

The elaboration of a new correlated yield table for cultivated teak forest is considered to be premature having regard to the young age of these forests.

3287 Arpornratana, P. 1963. **Bark thickness of teak at breast-height in various site and size**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Six plots were measured to calculate bark thickness. The bark thickness at breast-height increases for increase in diameter of 10 cm.

3288 Arun Kumar, A.N; Srinivasa, Y.B. 2003. **Stand level radial growth rate pattern reveals growth convergence in *Tectona grandis***. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Tested the hypothesis that radial growth rates of trees belonging to different radial classes converge towards the end of the juvenile phase through stump analysis of teak. Growth pattern of 168 teak trees was analyzed after classifying the trees into 4 cohorts based on the radial growth accumulated over the initial 20 years. Correlations show that growth upto 15 years had a significant impact on the cumulative growth. Discuss the implications of this study for the management of teak trees.

3289 Asiddao, F; Nastor, M. 1960. **Analysis of data on growth study of teak (*Tectona grandis* Linn.f.) in Bohol reforestation project, Colonia, Carmen, Bohol**. Philippine Journal of Forestry 16(3/4): 183-193.

Analyses increment data from a sample plot established in 1950.

3290 Bacilieri, R; Alloysius, D; Lapongan, J. 2000. **Growth performance of teak**. Proceedings of the Seminar on High Value Timber Species for Plantation Establishment Teak and Mahoganies, Sabah, 1-2 December 1998. JIRCAS Working Report 16: 27-34. H.H. Chan; K. Matsumoto, Eds.

The growth performance of teak in several regions of the world was studied and compared to the growth rates obtained in several trial plots in Malaysia. Formulae describing the relationships between age, height, volume, total timber yield and yield of stem wood in other regions of the world like Central America, Cote d'Ivoire, India were used to estimate the yield of plots in Sabah.

3291 Batista, M.P; Woessner, R.A. 1983. **Comparison of the growth of four exotic species on podzolic soils of the Amazon**. (Portuguese). Floresta 14(1): 29-35.

3292 Beekman, H. 1913. **Research into the most suitable method of measurement of teak stems in a stand**. (Indonesian). Tectona 6: 367-422.

3293 Beekman, H. 1915. **An investigation about the most accurate method of measuring teak tree and teak stands**. (Indonesian; English). Meded Proefsta Boschw 1: 93p.

3294 Beekman, H. 1917. **Investigation into the increment in secondary natural teak wood in North Japara**. (Indonesian; English). Meded Proefsta Boschw 2: 1-32.

3295 Bermejo, I; Canellas, I; San Miguel, A. 2004. **Growth and yield models for teak plantations in Costa Rica**. Forest Ecology and Management 189(1/3): 97-110.

Volume equations for commercial teakwood, site index curves and provisional empirical yield tables were developed for teak at Bosque Puerto Carrillo S.A. plantations in Costa Rica.

3296 Beumee, J.G.B. 1917. **Measurement of the height of the standing trees**. (Indonesian; English). Meded Proefsta Boschw 2: 33-48.

3297 Bhat, D.M. 1990. **Litter production and seasonality in tropical moist forest ecosystems of Uttara Kannada district, Karnataka**. Proceedings of the Indian Academy of Sciences, Plant Sciences 100(2): 139-152.

Small litterfall, ground litter and large wood litterfall were quantified at five forest sites including teak forests in Uttara Kannada district. Seasonal variation was distinct at monocultural sites and in vegetation types dominated by few species. Small litterfall and ground litter production were highest in the dry season and they were negatively correlated with mean monthly rainfall.

3298 Bhat, K.M; Indira, E.P. 1997. **Teak timber production in intensively managed plantations of the tropics**. Proceedings of the 11th World Forestry Congress, Antalya, Turkey.

3299 Bhudimitra, M. 1962. **Study of teak growth in permanent sample plots**. (Thai). Student Thesis. Kasetsart University, Bangkok.

In best soils the basal area increment annually is 59.737 sq. cm. per year per tree or 962.5833 sq. cm. per year per rai.

3300 Bhumibhamon, S. 1968. **The correlation between the growth in diameter of teak (*Tectona grandis* Linn.f.) and the depth of A-horizon at Klang dong teak plantation, 1956**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Diameter growth is significant to A-horizon depth (r=0.9872) and gives a regression y=-9.8779+2.1815 x. Again it was observed that diameter at 0.30 m is correlated with A-horizon depth (r=0.8934) and y=-11.0840+1.8569 x).

3301 Blanford, H.R. 1921. **Rough volume tables for teak (*Tectona grandis*) Pyinkado (*Xylia dolabriformis*), in (*Dipterocarpus tubercula-***

***tus*), Taukkyan (*Tetminalia tomentosa*), in Burma**. Burma Forest Bulletin (Silviculture 9) 10: 10p.

3302 Blanford, H.R. 1922. **Rough volume tables for teak, Tharrawady Division**. Burma Forest Bulletin 6 (Silviculture Series): 6p.

Based on measurements in Kyathaung and Myinwa and Tharrawady, curves are drawn from which volumes were read for different girths at b.h. for lengths of logs 3-10 ft. and average volumes of trees are presented in 3" girth classes. From volume curves volume tables are constructed in 6" girth classes and also increment is given for different areas.

3303 Boonyoparch, C. 1965. **Volume tables for some timber species of Thailand**. Royal Forest Department, Bangkok R.74. Kasetsart University, Bangkok.

Gives tables for teak for various diameters and girths.

3304 Boonyoparch, C. 1966. **Girth measurement of teak**. Proceedings of First Forestry Conference, Royal Forest Department, Bangkok: p282.

A new table for measurement of girth of teak is given which is already used for forest-inventory in North Thailand.

3305 Bourne, R. 1922. **Methods of preparing volume and money yield-tables for teak woods and volume and form-factor tables for teak trees from data collected in the Nilambur teak plantations of the South Malabar Division, Madras, S. India, 1916-1919**. Forest Department Ledger files, Madras and FRI, Dehra Dun.

3306 Brandis, D. 1879. **Memorandum on the rate of growth of teak**. Indian Forester 4(3): 215-225.

All available information is presented which cover information on girth and height at different ages, cubic content of tree at different ages and number of trees and cubic content of the growing stock per acre.

3307 Brasnett, N.V. 1950. **The Brandis system of yield regulation**. Journal, Oxford University Forestry Society (Series 3) 5: 15-22.

A detailed exposition of the method devised by Brandis in 1858 to regulate the yield of teak from the forests of Burma.

3308 Budiantho, D. 1986. **Site index model of teak (*Tectona grandis*) plantation**. (Indonesian). Buletin Penelitian Hutan, Pusat Penelitian dan Pengembangan Hutan 476: 46-61.

Data from selected dominant and codominant trees were used to derive a prediction equation for site index based on upper height and age of the stand.

3309 Budiantho, D. 1995. **Relationship of age, stand density and site index for diameter distribution of a teak stand (*Tectona grandis*, L.f.)**. (Indonesian). Buletin Penelitian Hutan 581: 11-36.

Test were made of the capability of the beta-function in representing the diameter distribution of teak stands. Diameter was expressed as a function of several variables, viz. age, site index, stand density, number of trees per hectare or average distance of trees per hectare. There were no significant differences in regressions based on the 4 different diameter measurements.

3310 Chakrabarti, S.K; Gaharwar, K.S. 1995. **A study on volume estimation for Indian teak**. Indian Forester 121(6): 503-509.

Inventory surveys were carried out for estimating the growing stock and has developed a number of local volume equations based on ground diameter mid-point. Two relationships have been established using the Method of Least squares; one is linear and the other a parabolic relationship. The volume of teak can be estimated using the parabolic relationship.

3311 Chalermpongse, A. 1992. **Growth performance in different age-classes of Huay-Tak teak plantation**. Proceedings of the Seminar on 50 Anniversary of Huay-Tak Teak Plantation, Lampang, 5-8 August 1992.

A study was made to assess the growth habits and yields of teak planted in Huay-Tak teak plantation, Lampang province, Thailand. The overall growing stocks of the teak plantation in term of merchantable volume in all age-classes was illustrated and the mean volume provided.

3312 Champion, H.G. 1932. **Branch and small wood tables for *Shorea robusta* and *Tectona grandis* etc**. Indian Forest Records (Silviculture Series) 15(6).

3313 Champion, H.G. 1934. **Rough volume tables for teak**. Indian Forester 60(10): p724.

Recommended for use in all teak growing areas.

3314 Champion, H.G. 1934. **Von Wulfing's yield tables for teak plantations in Java**. Indian Forest Bulletin 87: 30p.

Wulfing's yield tables are converted from metric to British system and compared with growth rates and yield tables for Nilambur plantations. Observations are made on site qualities and growth rates at both places.

3315 Chandhrapanukorn, B. 1964. **Correlations between diameter at breast height, height of buttress and diameter at the buttress height of teak**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The study establishes a correlation between dbh and diameter at highest point of buttress and dbh and height of buttress and diameter at the highest point of buttress and height of buttress.

3316 Chanpaisaeng, S. 1992. **Yield of teak plantation**. Proceedings of the Seminar on 50 Anniversary of Huay-Tak Teak plantation, Bangkok, 5-8 August, 1992.

3317 Chaturvedi, A.N. 1973. **General standard volume tables and height/diameter relationship for teak (*Tectona grandis*)**. Indian Forest Records, Silviculture 12(8): 1-8.

Presents tables for merchantable timber volumes and small wood volumes and two regression equations for height/d.b.h. relations of teak, based on data from Kerala, Madhya Pradesh, Mysore, Orissa, Tamil Nadu and Uttar Pradesh.

3318 Chiao, K.M. 1968. **Relationships of dbh, basal diameter and diameter at 5.3 m. in *Cryptomeria japonica* and teak**. (Chinese). Exp. For. Taiwan University, Miscellaneous Paper 40: 20p.

3319 Chittranshi, V.N; Chitwadgi, S.S. 1971. **Standard volume table for teak for South Chindwara Division in Madhya Pradesh**. Technical Bulletin 9.

3320 Choosapya, Ch. 1962. **A volume of teak branches as determined from 5 c.m. diameter to the tip**. (Thai). Student Thesis. Kasetsart University, Bangkok.

For d.b.h. class 30-35, 35-40, 40-45, 45-50, 50-55, 55-60 and 60-65 cm, the volume of the branches 0.071 m3, 0.086 m3, 0.101 m3; 0.114 m3; 0.137 m3 and 0.174 m3 respectively.

3321 Chotiyabutta, S. 1961. **Correlation between the depth of A-horizon and teak height in Mae-Huad teak plantation (1942)**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Sixty-six experimental plots were laid out in 410 Rai within radius 12.65 m and soil depth upto 12 cm was examined and no significant correlation was observed.

3322 Chowdhury, K.A. 1952. **Rate of growth and quality of tropical woods**. Forest Research Institute, Dehra Dun: 2p. (6th British Commonwealth Forestry Conference, Canada, 1952).

The correlations between strength and rate of growth that have been established for timbers of the temperate zone are only partially applicable to tropical timbers. In the ring-porous teak, very fast-grown wood is weak and spongy.

3323 Cordero, L.D.P; Kanninen, M. 2003. **Provisional equations for estimating total and merchantable volume of *Tectona grandis* trees in Costa Rica**. Forests, Trees and Livelihoods 13(4): 345-359.

A study is made to develop equations to predict individual tree total volume and merchantable volume for teak in plantations in Costa Rica.

3324 Cordero, L.D.P; Kanninen, M. 2003. **Above ground biomass of *Tectona grandis* plantations in Costa Rica**. Journal of Tropical Forest Science 15(1): 199-213.

This paper reports the distribution of aboveground biomass of teak and its relationship with diameter at breast height, age and stand density in plantations across Costa Rica. Foliage, branch, stem and total aboveground biomass were highly correlated with dbh and age.

3325 Cordero, L.D.P; Ugalde Arias, L.A; Kanninen, M. 2000. **Development of growth scenarios for teak (*Tectona grandis*) plantations in Costa Rica**. (Spanish). Revista Forestal Centroamericana 31: 16-22.

A study was made with the objective of developing preliminary forest management proposals for teak plantations to ensure high stand productivity. Models were developed for different relationships among the variables crown composition, crown structure, growth and productivity, using information from advanced aged teak plantations in Costa Rica.

3326 Das, M; Baruah, C.K. 1996. **Studies on seasonal variation in the leaf litter production of teak (*Tectona grandis* Linn.f.)**. Advances in Plant Sciences 9(1): 85-92.

Leaf litter production was studied on the forest college campus at Jalukbari, Assam. There was variation in litter production between sites and seasons. The trend was a gradual increase from January, reaching a peak in March, and then a sharp fall after March, reaching a minimum in June. A second gradual increase was observed from July onwards.

3327 Das, S. 1966. **Standard volume tables for Bori (Hoshangabad) teak**. Indian Forest Records (n.s.) (Statistical) 1(2): 51-60.

The tables were constructed from regression equations of volume on basal area.

3328 Datta, M. 1997. **Growth performance and biomass production in twelve multipurpose tree species in Tripura**. Journal of Hill Research 10(1): 51-56.

Growth performance and above-ground biomass productivity were recorded for twelve multipurpose tree species including *Tectona grandis* planted in an arboretum at Tripura. Fresh leaf biomass and stem volume were highly correlated with basal girth, girth at breast height and height of the tree species in the arboretum.

3329 De Milde, R.A.J. 1984. **Some practical tables to estimate the potential of teak plantations**. 12p.

3330 Deventer, A.J van. 1923. **Production of teak in the intensively managed forest districts of Java**. (Dutch; English). Tectona 16: 7-39.

Figures in tables indicate a correlation between transportation facilities and production of best classes of timber, and inadequate facilities result in low production and results indicate intensifying the management of teak forests.

3331 Deventer, A.J van. 1925. **Production of teak in Java**. Botany Abstract 14: p498.

3332 Draaisma, C.L.M. 1917. **Observations on diameter growth in teak**. (Dutch). Tectona 10: 575-580.

3333 Dupuy, B; Maitre, H.F; Kanga, A.N. 1999. **Teak (*Tectona grandis*) production table: The Cote d'Ivoire example**. (French). Bois et Forests des Tropiques 261: 6-16.

Constructed a yield table using data from sample plots in teak plantations in the Cote d'Ivoire and discussed yield classes for this species, which is planted from the savanna region in the north of the country to closed evergreen forests of the southern coastal regions. Five distinct productivity levels, associated with site fertility and rainfall, have been noted.

3334 Ferguson, J.H.A. 1934. **Thickness of heartwood and sapwood of teak (*Tectona grandis* Linn.f.)**. (Dutch; English). Tectona 27(5/6): 313-327.

From the investigations carried out it appears that for the same stem diameter there is more sapwood if the growth is faster as is the case of better quality areas. It also appears that the sapwood increases with the height of the cross section above the ground.

3335 Ferguson, J.H.A. 1934. **On the correlation between sapwood and total leaf weight in teak**. (Dutch; English). Tectona 27: 512-513.

3336 Ferguson, J.H.A. 1935. **The stem volume of plantation grown teak (*Tectona grandis* Linn.f.)**. (Dutch; English). Tectona 28(2): 83-94.

The mean height of crown base which depends on age did not change with quantity. Mean height of crown base in meters and total stem volume under bark for 5-100 years are given.

3337 Ferguson, J.H.A. 1950. **Indicator graph for Java teak**. (Dutch; English). Tectona 40: 359-364.

The indicator graph constructed for teak after Hiley (1930) and money yield tables of Hellinga (1940) is explained. Hiley's and Faustmann's formula are also discussed.

3338 Ferguson, J.H.A. 1953. **Considerations on the computation of diameter growth by diameter classes, from stand tables**. Proceedings of Congress of International Union of Forest Research Organisations, Rome, 1953 Section 25(2): 9p.

The results of determining increment using Prodan's method, either from individual tree diameter records or from stand tables, are compared for species including teak.

3339 Fischer, C.E.C. 1922. **Rate of growth of teak for Trinidad**. Indian Forester 48(4): 213-214.

Gives a brief history of the introduction of teak in Trinidad, method of razing the plantations and subsequent care. Figures of growth rate is also given.

3340 Forest Department, Burma. 1934. **Rough volume tables for teak (*Tectona grandis*)**. Burma Forest Bulletin 31: 1-97.

The outturn volume tables are given for 25 forest divisions. To facilitate selection, a brief description of the locality is also given in respect of each type.

3341 Forest Department, Sudan. 1954. **Rate of growth of teak (*Tectona grandis*)**. Report of Forest Department, Sudan 1952/53: 42-43; 46-50.

Measurement of sample plots of teak in different parts of the southern Sudan shows that, in general, diameter growth is better than for trees of the same height grown in India. On the better sites growth is equal to All India quality II, which is the first quality of the Nilambur plantations in Madras. Even the lower quality teak has already produced a considerable revenue from thinnings, as its straight clean poles are in high demand.

3342 Forest Department, Uttar Pradesh. 1967. **On a giant teak tree in S. Chanda Division, Maharashtra**. Aranya, November 1967: p10. Forest Department, Uttar Pradesh.

Mention is made of a teak tree with the following measurements in South Chanda division, Maharashtra state: height - 43 m, Diatmeter - 792 cm.

3343 Forest Research Institute, Dehra Dun. 1917. **Teak growth statistics**. Indian Forest Records (n.s.) Silviculture 6(2): 42p. Forest Research Institute, Dehra Dun.

3344 Forest Research Institute, Dehra Dun. 1928. **Teak volume tables for Central Provinces**. Forest Research in India, Forest Research Institute, Dehra Dun: p78.

3345 Forest Research Institute, Dehra Dun. 1932. **Branch small-wood tables for *Shorea robusta*, *Tectona grandis*, *Cedrus deodara*, *Pinus excelsa*, and *P. longifolia***. Indian Forest Records (n.s.) Silviculture 15(6).

3346 Forest Research Institute, Dehra Dun. 1959. **Yield and stand tables for plantation teak (*Tectona grandis* Linn.f.)**. Indian Forest Records (n.s.) Silviculture 9(4): 151-216.

Four quality classes are distinguished. The revised yield tables show comparatively less height growth for all site quality classes as compared to the previous one but comparatively higher diameters for the same age and the same quality.

3347 FORSPA, Bangkok. 2000. **Site, technology and productivity of teak plantations**. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 273p. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

Selected papers presented at the seminar are compiled. A paper on the global situation of teak plantations and several papers highlighting teak plantation management issues in different countries like Bangladesh, Brazil, China, Costa Rica, Cote d'Ivoire, India, Indonesia, Malaysia, Myanmar, Sri Lanka and Vietnam are included. Papers dealing with specific topics such as tree improvement, mass propagation, disease and pest management, and productivity and economics are also included.

3348 Friday, K.S. 1987. **Site index curves for teak (*Tectona grandis* Linn.f.) in the limestone hill region of Puerto Rico**. Commonwealth Forestry Review 66(3): 239-253.

Height growth curves are proposed for site index classification in this subtropical moist to wet region. The new curves are similar to those for Burma, Trinidad and the Caribbean/Central American region. Most plantations had a reasonably good site index.

3349 Ghosh, R.C. 1968. **Productivity of North Bengal plantations-a study**. 9th Commonwealth Forestry Conference, New Delhi 1968.

Included the history of the plantation and data on increment and yield of teak.

3350 Gilbert, G. 1932. **Growth of teak in Dutch East Indies**. Boil Abstract 6(22965).

3351 Gonzales, L.L. 1985. **Growth and yield prediction model for teak (*Tectona grandis* Linn.f.) plantations in the Magat Experimental Forest. Part 1. Tree volume equations and tables**. Sylvatrop 10(4): 231-241.

Volume equations and tables were developed for merchantable and saw timber heights from models chosen by stepwise regression with data from Nueva Vizcaya, Philippines.

3352 Gonzalez, R.M. 1970. **The yield of forest plantations in the tropics**. (Spanish). Annales Cientificos, Departamento de Publicaciones de la Universidad Nacional Agraria, La Molina 8(1/2): 109-121.

Included published information on the yield of plantations of *Tectona grandis* in tropical Latin America.

3353 Gouveia, V.M; Angelo, H. 2002. **Economic analysis of carbon fixation and storage in a population of *Tectona grandis* Linn.f.** (Portuguese). Brasil Florestal 21(74): 23-36.

An economic investigation of carbon fixation and storage due to the production of a population of *Tectona grandis* in order to determine its rotational period is made. Using volumetric production and density data, the oven-dry mass and carbon content was fixed upon 50 percent.

3354 Goyal, A.K. 2001. **Giant teak tree located in Malayattoor Forest Division, Thrissur, Kerala**. Indian Forester 127(6): p729.

The giant teak, *Tectona grandis*, growing in Malayatoor Forest Division, Thrissur, Kerala and another one near it are described.

3355 Grainger, A. 1988. **Future supplies of high grade tropical hardwoods from intensive plantations**. Journal of World Forest Resource Management 3: 15-29.

Projections were made of future production of high grade tropical hardwoods including teak from intensive forest plantations for 30 countries in the humid tropics for the period 1981 to 2026.

3356 Griffith, A.L. 1946. **The efficiency of enumerations. XII. One species in a mixed forest (teak in a Madras moist mixed deciduous forest). XIII. Confirmation of the Chir (*Pinus longifolia*) and sal (*Shore robusta*) data. XIV. Summary of indications**. Indian Forest Leaflet (Silviculture) 93: 14p .

Dealt with enumerations of teak in Madras moist mixed deciduous forest.

3357 Habibullah Sahib, M. 1918. **Measurement of a teak tree**. Indian Forester 44: p468.

Gives dimensions of a big teak tree felled in Tekkadi forests of South Coimbatore Division. The tree had a girth of 18'7" at b.h. and 30' length of workable stem, which on felling yielded 11 logs of 129 ft. length and 711 cu.ft. of timber.

3358 Haeruman, H. 1965. **Top height in the classification of teak stands**. Rimba Indonesia 10(4): 275-282.

Site class of even-aged stands in Indonesia is determined by using age, mean diameter, mean height and top height.

3359 Harne, J.E.M. 1962. **Growth rates in the timber plantations of Western Nigeria.** Nigerian Forest Information Bulletin 12: 16p.

Tabulated data on height, g.b.h., basal area, volume and increment is given for teak and other species.

3360 Hellinga, G. 1939. **Stand table for normal teak plantations thinned in the lower storey**. (Dutch). Boschbouwproefstation, Buitenzorg: 96p.

3361 Hobbins, R. 1935. **Some notes on the percentage loss in the timber volume of teak due to bad form, natural defects and breakage in felling**. Indian Forester 61(11): 693-698.

The average percentage of loss of timber by butting due to splits, cracks, bear bites, top hollows, felling damages and all defects was estimated to be 7.32 percent in volume.

3362 Hole, R.S. 1901. **Irregularity in the growth of teak**. Indian Forester 27(8): 393-397.

The author is of the opinion that the extraordinary irregularity on the growth of teak is due to insect attack and defoliation by *Paliga damastesalis* and *Hyblaea puera*.

3363 Hollerwoger, F. 1954. **Is there a correlation in the teak forests between crown diameter and the height of the trees with regard to the diameter at breast height?** Journal of Scientific Research in Indonesia 3(1): 3-20.

Results of a survey made in a teak area in Ledok, Central Java, show that there exists no direct relation between crown diameter and stem diameter because of the fact that teak reaches its maximum crown diameter at an age when d.b.h. is still steadily increasing and in old trees, crowns may become smaller, whereas d.b.h. may still increase.

3364 Hoque, M.A. 2000. **Site, technology and productivity of teak plantations in Bangladesh**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 35-50. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

Bangladesh has a long history of teak plantation management and most plantations are owned by the Government. In addition plantations raised by private enterprises, industries, semi-autonomous corporations, farmers and small holders are also there. Activities initiated by the Bangladesh Forest Research Institute to meet the demand for superior stock of teak are discussed. A financial analysis of teak plantation in Bangladesh is also made.

3365 Isfiati, S. 2001. **Evaluation of the stumpage value growth on teak forest in KPH Jember PT Perhutani Unit II East Java**. (Indonesian). Jurnal Sosial Ekonomi 2(2): 99-110.

It is showed that the physical stumpage and monetary growth of teak stands increased between 1979 and 1989 and decreased during 1989-99. It is suggested that an understanding of the annual forest resource growth could be used for evaluating forest management on sustainable principles.

3366 Islam, S.S. 1984. **Volume tables for some indigenous forest species in Bangladesh**. Bangladesh Forest Research Institute, Forest Inventory, Bulletin 3: 70p.

Developed 15 regression models of tree volume and the models were compared and the best used to compute single and double entry volume tables. These are presented for 14 species including *Tectona grandis*.

3367 Islam, S.S. 1988. **Commercial volume table for teak (*Tectona grandis* Linn.f.) in Bangladesh by regression technique**. Bano Biggyan Patrika 17(1/2): 55-67.

Commercial volume tables were derived for teak. Thirteen models of the variation of volume with d.b.h. and with d.b.h. and height were compared. Equations are given for the relations between d.b.h. and height. One- and two-way volume tables based on the equations are presented.

3368 IUFRO. 1981 . **Industrial wood production via plantations: A. Growth, yield, economics**. Wood production in the neotropics via plantations. IUFRO MAB USDA Forest Service. IUFRO Working Group S1.07.09, Puerto Rico, 8-12 September 1980: 18-135.

Included two papers on teak by Keogh, R.M. 1. Teak (*Tectona grandis* Linn.f.) Volume growth and thinning practice in the Caribbean, Central America, Venezuela and Colombia. 2. Teak (*Tectona grandis* Linn. f.): Provisional site classification chart for the Caribbean, Central America, Venezuela and Colombia.

3369 Iyer, K.R.V. 1913. **The tallest teak tree in the Shola forest, South Malabar, India**. Indian Forester 39(4): 173-175.

Reported a teak tree in Edkulli shola forests in Kahumpoya valley with 192 ft. in height and clean bole up to 1st branch of 114 ft. and g.b.h. is 15'10" at 4.5' b.h. and age estimated to be over 200 years.

3370 Jayaraman, K. 1998. **Structural dynamics of teak stands in Kerala**. KFRI Research Report 141: 28p. Kerala Forest Research Institute, Peechi.

Teak plantations in Kerala under the management of the Forest Department occupied around 78 225 ha in 1992. The teak plantations falling under the Territorial Circles were assessed for stocking and site quality distribution using a stratified sampling procedure, based on Territorial Circles and age groups. It is found that 36 percent of the plantation area was under stocked, and 45 percent overstocked. Data are presented on the status of these plots with respect to stand attributes such as age at measurement, stand density, site quality class etc. The consequence of bringing the plantations to normality in one rotation period was also investigated.

3371 Jayaraman, K; Bailey, R.L; Rugmini, P. 1986. **Height measurements of plantation grown teak using multimeter and relascope**. Malaysian Forester 49(3/4): 313-316.

The relative accuracy of height measurements made using a relascope and a multimeter was investigated in Kerala. Average differences between the measurements were 13 percent. There was no systematic difference in measurements made by the 2 instruments.

3372 Jayaraman, K; Chacko, K.C. 1999. **Modelling the growth of teak and real time monitoring of tree health in STM teak plantations**. KFRI Research Report 175: 22p. Kerala Forest Research Institute, Peechi.

The works executed with the objective of developing a Management Information System (MIS) for plantations owned by STM are reported. The data collected include location details, several attributes related to growth and health of trees, soil status, input operations carried out and weather conditions in the plantations. The overall mean annual increment of height in STM plantations during the initial three years of growth was found and compared of All India Yield Table for teak.

3373 Jayaraman, K; Krishnankutty, C.N. 1990. **A data bank for forestry sector in Kerala**.

KFRI Research Report 66: 27p. Kerala Forest Research Institute, Peechi.

Teak and eucalypts account for the major share of the area under plantations in Kerala. A computerized data base and retrieval system was developed for plantations in Kerala, with reference year 1978-88. The system was instantly retrieve information pertaining to any set of plantations in the State with regard to the location, species and year of planting. The utility of such a management information system is demonstrated by making projections of yield from teak plantations in Kerala in a full rotation age in the future.

3374 Jayaraman, K; Lappi, J. 2001. **Estimation of height diameter curves through multilevel models with special reference to even-aged teak stands**. Forest Ecology and Management 142(1/3): 155-162.

The use of a multilevel model for estimation and prediction of height-diameter curves in planted teak stands is discussed in the context of analysing data from a stratified two-stage sample survey. Differences in the height-diameter curves among the different Territorial Divisions were also investigated. The models are useful in generating accurate predictions of tree height which would eventually lead to better tree volume predictions and evaluation of site quality.

3375 Jayaraman, K; Nandakumar, U.N; Rugmini, P. 1987. **Estimation of stocking in teak plantations**. Indian Journal of Forestry 10(1): 60-61.

A high coefficient of variation was found in estimations of mean stocking in a teak plantation established at Nilambur, Kerala. Theoretical sample sizes required to estimate stocking with specified levels of accuracy were determined by Rustagi's formula which indicated a need for a sampling intensity of 11.25 percent for a 95 percent confidence level. This is not practical in the field.

3376 Jayaraman, K; Rugmini, P. 1988. **Diameter distributions for even-aged teak**. Indian Journal of Forestry 11(2): 145-147.

The suitability of the mathematical functions, weibull and the beta distributions for representing the frequency distribution of diameter in even-aged teak was tested using the data on diameter at breast-height collected from plantations at Nilambur, Kerala. The observed diameter distribution was nearly symmetrical and platykurtic and was better fitted by the more flexible beta distribution than by the weibull distribution.

3377 Jayaraman, K; Rugmini, P. 1993. **Variation in the productivity of teak plantations in Kerala**. Proceedings of the 5th Kerala Science Congress, Kottayam 28-30 January 1993: 179-181. R. Ravikumar, Ed. State Committee on Science, Technology and Environment, Thiruvananthapuram.

Variation in the productivity levels of teak plantations raised during the last one rotation period was examined. There were distinct regional differences in productivity with respect to the proportion of area under different site quality classes. The range of variation could be partitioned into three natural levels of low, medium and high productivity and regions falling in these classes could be identified through clustering procedure. The average expected yields worked out for the three clusters showed large difference which have implications on the management of these plantations.

3378 Jha, M; Puranik, C.P; Subramanian, K. 1998. **Stand development patterns in pure teak plantations**. Indian Journal of Tropical Biodiversity 3/6(1/4): 1-5.

This paper presents the stand development patterns in a teak plantation and is compared with the mature natural teak stand. Results indicate that teak plantation after clear felling approaches towards the natural stand as appeared from ratios of non teak trees to teak trees. It will help for the study of stand dynamics and yield prediction.

3379 Jiayu, B; Kunnan, L. 2000. **Site, technology and productivity of teak plantations in China**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 123-136. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

Discussed the condition under which teak is grown, management practices and establishment and maintenance costs of teak in China. Author is of the opinion that due to the application of better planting techniques and the use of improved seeds, teak plantations have a bright future in China.

3380 Jinaporn, B. 1966. **Study on the correlation between volume of teak in natural forest and stand profile**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The natural forest volume is found to be 14.66 m3/0.1 ha. and the stand profile is 1962.88 m3/0.1 ha.

3381 Jones, N. 1964. **Provisional volume table for teak**. Department of Forest Research, Nigeria, Technical Note 32: 10p.

Local tables for the three largest W. Nigeria plantations.

3382 Kaitpraneet, W; Sukwong, S. 1974. **Height growth of teak (*Tectona grandis* Linn.f.) as related to environmental factors**. Forest Research Bulletin, Faculty of Forestry, Kasetsart University, Thailand 30: 21p.

A regression analysis for the estimation of height was derived from data on stand, soil and topographic factors in teak plantations of different ages in N. Thailand. It was found from the equation that teak requires soil of deep A-horizon with adequate soil moisture for development and as the number of stems per rai decreases, height growth increases.

3383 Kandya, A.K. 1973. **Notes on net primary production in teak (*Tectona grandis* Linn. f.)**. Journal of the Indian Botanical Society 52(1/2): 40-44.

Reports a study of annual dry-matter production by seven trees growing in dry deciduous mixed teak forests near Sagar, Madhya Pradesh. The results, based on actual weighings of the various plant parts after felling, indicate that maximum productivity of 25.81 kg/year/tree occurs between 33 and 50 years of age.

3384 Kandya, A.K. 1974. **Weight dynamics in immature *Anogeissus*, *Tectona* and *Terminalia***. Indian Forester 100(2): 93-100.

It is found that for the species including teak, total above-ground dry weight per tree was 80-83 kg.

3385 Karmacharya, S.B; Singh, K.P. 1992. **Biomass and net production of teak plantations in a dry tropical region in India**. Forest Ecology and Management 55(1/4): 233-247.

An analysis of the standing crop biomass and above-ground net production was made by non-destructive methods. Allometric regressions were developed relating girth to weights of bole wood, bark, branch, leaf and inflorescence. Annual girth increments were recorded and above-ground biomass is found ranged from 25.7 to 76.9 t/ha.

3386 Karunakaran, C.K. 1984. **Biomass of Kerala forests**. Indian Forester 110(9): 841-853.

Preliminary estimates are given of the growing stock per ha of the different types of natural and man-made forests in Kerala. For teak and *Eucalyptus tereticornis* plantations they are as low as 70-80 m3 and 30 t.

3387 Keogh, R.M. 1990. **Growth rates of teak (*Tectona grandis*) in the Caribbean/Central-American region**. Forest Ecology and Management 35(3/4): 311-314.

Previous examinations of teak in Caribbean and Central America suggested a slowing down in height growth through time in comparison with teak in indigenous areas. It was suggested that, in the case of an existing regional classification chart, the basic model used might be responsible for this observation rather than biological factors.

3388 Keogh, R.M. 1996. **Teak 2000: A consortium support model for greatly increasing the contribution of quality hardwood plantations to sustainable development**. IIED Forestry and Land Use Series 9: 26p. International Institute for Environment and Development, London and The Amazon Teak Foundation, Amsterdam.

Consortium Support Model (CSM) is a system under which financial and technical support will be given to groups of teak growers to enable them to produce more and better quality teak in a socially and environmentally preferred manner. The CSM is designed to satisfy environmental requirements as well as to benefit investors, growers, processors, local communities and the market. The aims of the model are discussed and justified, and its structure is described.

3389 Kesornsiri, K. 1968. **Teak stem-analysis in Trachai teak plantation**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The height, basal area and volume of first year and at the age of 25 years are provided for teak.

3390 Khali Aziz Hamzah; Azmy Hj Mohamed. 1994. **Volume equations and tables for teak (*Tectona grandis* Linn.f.) in Mata Ayer, Perlis, Malaysia**. Forest Research Institute Malaysia Reports 65: 19-33. Forest Research Institute Malaysia, Kuala Lumpur.

The paper attempts to establish equations which best relate the relationship between volume, diameter at breast height and total height, by the least squares method, for the construction of volume tables for *Tectona grandis*.

3391 Khemnark, C. 1962. **Local merchantable volume tables of teak at Mae-Huad forest, Lampang**. (Thai). Student Thesis. Kasetsart University, Bangkok.

For the form-class 0.739 the volume table can be used for teak which has a form class equal to that volume by measuring d.b.h. and merchantable height.

3392 Kittinanda, S.P; Yingransiri, T. 1968. **Annual increment of teak plantation at Mae-Huad and Huay-Rai in different ages**. (Thai; English). Proceedings of the Forest Silvicultural Seminar, Royal Forest Department, Bangkok R 118: 203-209.

The growth of teak in Mae-Huad plantation in first three years is faster and is attributed to fertile soils of the forests, where as in other areas the fertility of soils is poor due to shifting cultivation. The general condition of forest soils and their fertility status are discussed.

3393 Kivung, D. 1986. **The growth and yield potential of teak (*Tectona grandis* Linn.f.) in Papua New Guinea plantations**. Klinkii 3(2): 2-19.

Growth data were collected at two sites by the methods of destructive sampling and photogrammetry and used to compile volume tables. Graphs showing height and diameter growth, and tables giving site quality data and d.b.h. and b.a. increment from 5 to 16 yr old are also given.

3394 Klaithong, P. 1964. **Estimation of production in mixed-deciduous forests with teak**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The production in wet-mixed deciduous forest is estimated as 26.7 tons/Rai of which teak is 12.6 tons/Rai.

3395 Krishnapillay, D.B; Ali, A.R.M. 2000. **Site technology and productivity of teak: The Malaysian experience**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 109-122. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

Teak was introduced to Malaysia during the British colonial period. Teak shows good growth rates and financial returns in Malaysia. Distribution, ecological requirements of teak, experience with teak in Malaysia and financial feasibility of planting teak are discussed.

3396 Kudindhra, U. 1965. **Study on crown-spreads in 1-20 years old teak plantations**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Average crown coverage is estimated as 0.26m/year and age and crown spread is correlated.

3397 Kuerkool, P. 1965. **Study on the relationship of d.b.h. and root spreads of teak in teak plantations of different ages**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The study indicated no statistical relation between d.b.h. and crown spread, but between d.b.h. and root spread.

3398 Kumar, A.N.A; Srinivasa, Y.B; Chauhan, S.S. 2002. **Growth rate convergence in teak (*Tectona grandis* Linn.f.)**. Current Science 83(7): 808-809.

Rings of teak trees from three sites were collected to determine the variation in their growth pattern. From the ring widths frequency, trees were categorized into four size cohorts, very small, small, medium and large radius. The growth rates of tree cohorts showed that the cohort with large radius had the highest growth rate and the cohort with very small radius had the lowest growth rate.

3399 Kumar, B.M; George, S.J; Chinnamani, S. 1994. **Diversity, structure and standing stock of wood in the home gardens of Kerala in peninsular India**. Agroforestry Systems 25(3): 243-262.

A survey was conducted in selected thaluks of Kerala state to elucidate the floristic structure, composition and the extent of similarities and diversities in the composition of home gardens. The potential of the home gardens to supply commercial timber and fuelwood was also assessed. Farmers prefer timber trees such as teak, Ailanthus and fruit trees such as mango, jack and cashew.

3400 Kumar, B.M; Long, J.N; Kumar, P. 1995. **A density management diagram for teak plantations of Kerala in peninsular India**. Forest Ecology and Management 74(1/3): 125-131.

A density management diagram was constructed using stand inventory data from teak plantations in Western Ghats of peninsular India. The diagram's utility in predicting the consequences of stand density manipulations is illustrated for pole and log production.

3401 Kumar, P.D; Rajesh, N; Kumar, A.V.S; Vidyasagar, K; Anaz, M.A. 1997. **Crown diameter/bole diameter relationship as an aid to thinning in teak (*Tectona grandis* Linn.f.)**. Indian Journal of Forestry 20(4): 355-361.

A field study was conducted in the teak plantations of Kerala to develop thinning guidelines based on the relationship between crown diameter and bole diameter. A good correlation was demonstrated between crown diameter and bole diameter and the teak trees were shown to use space more efficiently with increase in size.

3402 Kushalappa, K.A. 1984. **Commercial productivity of Kanara forests, Karnataka**. Indian Forester 110(7): 644-654.

An account is given of materials and revenue obtained from fellings in the natural forests and from thinnings in teak plantations.

3403 Kyi, Maung. 1963. **Two critical problems currently facing teak yield regulation and some practical suggestions**. Burmese Forester 13(1): 6-13.

Criticizes the current practice in Burma and urges the regulation of yield on a volume or basal area basis.

3404 Kyi, U. 1960. **A note on fixation and control of teak yield in Mohnyin reserve**. Burmese Forester 10(2): 101-107.

A note prepared for teaching purposes.

3405 Kyi, U. 1961. **Teak yield regulation in Burma**. Burmese Forester 11(2): 109-115.

Describes the modern outlook on yield regulation and briefly discusses the factors for consideration in the choice of yield regulation method. The development of methods of teak yield regulation in Burma is traced.

3406 Laan, E.van der. 1930. **The yield of teak plantations**. (Dutch; English). Tectona 23: 659-664.

Author compared the real output of teak plantations after cutting with Berkman's yield table for teak. The real output varied from 65 to 132 pecentage from calculated figures.

3407 Lahiri, A.K. 1996. **Pole yield of some softwood and hardwood species grown in Bangladesh**. Journal of the Timber Development Association of India 42(3): 21-24.

Growth study on nine timber species planted in Bangladesh soils revealed that six species fall under the wooden electric pole yield group-A, ie. they produce 33 percent poles within 10 years another 33 percent within 15 years and additional 33 percent within 20 years of rotation. The species include *Tectona grandis*.

3408 Lalman; Misra, A. 1981. **Dry matter production by some tropical forest tree seedlings**. Van Vigyan 19(1): 1-13.

In *Tectona grandis* there was an inverse relation between leaf and root dry weight in 0-12 month old seedlings growth. Net primary productivity of all species increased with age. Litter production was more in *Tectona grandis* than *Terminalia arjuna*.

3409 Latif, M.A; Khan, A.F.M.K; Hossain, M.M. 1998 . **Stump diameter-dbh-volume relationships for teli garjan (*Dipterocarpus turbinatus*), dhakijam (*Syzygium grande*) and teak (*Tectona grandis*) in Bangladesh**. Bangladesh Journal of Forest Science 27(1): 16-24.

Diameter at breast height and diameters at stump heights were measured for standing trees of teak along with other trees in plantations in Bangladesh. Equations are given for stump diameter-dbh relationships.

3410 Laurie, M.V; Ram, B.S. 1940. **Yield and stand tables for teak (*Tectona grandis* Linn.f.) plantations in India and Burma**. Indian Forest Records (n.s.) Silviculture 4-A(1): 115p.

This is the first attempt at a comprehensive yield table for teak plantations throughout India and Burma. A table of top height by site quality and age, stand tables, espacement tables by age and site quality and by average crop and various stand data are also included.

3411 Lin, T.Y. 1975. **A method for prediction of yield on the unstocked land or cut-over area for silviculturing**. (Chinese). Quarterly Journal of Chinese Forestry 8(3): 1-24.

Describes how multiple regression analysis may be used to predict site quality from site factors. Provisional yield tables are presented for three site classes in Taiwan. It is suggested that the method may be used to select suitable areas and tree species for silviculture.

3412 Liu, S.H; Hung, L.B. 1950. **Studies on the increment of teak in coppice forest and of planted trees (*Tectona grandis* Linn.f.)**. (Chinese). Bulletin of Taiwan Forest Research Institute 22: 24p.

Measurements were made for 2 to 3-year-old coppice from trees felled at 30 years. Measurements of planted trees were made by stem analysis on 8 wind-thrown trees.

3413 Lizano, M.H.C; Salazar, R. 2000. **Evaluation of teak and *Gmelina* plantations in the Huetar Norte region in Costa Rica for use as seed stands**. (Spanish). II Simposio sobre avances en la produccion de semillas forestales en America Latina: Memorias, Santo Domingo, Republica Dominicana, 18-22 de octubre, 1999: 61-63. Centro Agronomico Tropical de Investigacion y Ensenanza (CATIE), Turrialba Costa Rica.

An evaluation of twelve teak and *Gmelina arborea* plantations was carried out. Evaluation parameters of diameter at breast height, trunk shape and number of trees/ha have been included.

3414 Lopez. 1932. **Growth of teak in Brazil**. Tropical Woods 32: 33p.

3415 Lugo, A.E; Brown, S; Chapman, J. 1988 . **An analytical review of production rates and stemwood biomass of tropical forest plantations**. Forest Ecology and Management 23(2/3): 179-200.

Data on stemwood biomass and mean annual biomass increment for seven tropical tree plantation species including *Tectona grandis* were synthesized from the literature to evaluate species adaptability and potential yields in different environments. Stemwood biomass and MABI varied with species, plantation age, and climate. Linear models described the relationship between stemwood biomass and age of plantation.

3416 Lushington, P.M. 1895. **Rate of growth of teak**. Indian Forester 21(1): p56.

Gives dimensions of teak trees in a 19 year old plantation in Nilambur.

3417 Malende, Y.H; Temu, A.B. 1990. **Site index curves and volume growth of teak (*Tectona grandis*) at Mtibwa, Tanzania**. Forest Ecology and Management 31(1/2): 91-99.

Height curves for 4 site indices at age 20 yr are compared with those from Nigeria, C. America, Java and India. It is predicted that rotation age of 60 yr will yield approximately 600 m3/ha of wood.

3418 Mammen, C. 1998. **Teak plantations in Nilambur: An economic review**. KFRI Research Report 144: 71p. Kerala Forest Research Institute, Peechi.

Analysed the productivity and profitability of teak plantations in Nilambur, Kerala. Yield data were collected for the period 1967-94 from an area of 12 500 ha. The mean yield in a rotation of 53 yr was 151 m3 ha-1. The average yield is reported correspond to that of site quality IV. The average site quality was far below that of the lowest class. It is suggested that careful analysis is required to specify the magnitude of deterioration and the reasons for this.

3419 Marsden, R.E. 1908. **The effect of aspect on the growth of teak**. Indian Forester 34(10): 592-593.

Gives the average increment of teak on different aspects in Myittha Forest Division, Burma. The best aspect for teak in these forests appears to be a north-westerly one and the next best a northerly one while the worst is an easterly aspect.

3420 Mathauda, G.S. 1954. **Relationship between the average diameters of the main and the subsidiary crops in the case of plantation teak (*Tectona grandis* Linn.f.)**. Indian Forester 80(11): 707-708.

Average diameters of thinnings were plotted against those of main crop, for 4 site qualities and 2 grades of thinning. The distribution of points indicated that the relationship is independent of both site quality and thinning grade within the range of C and D grades of ordinary thinnings.

3421 Mathauda, G.S. 1955. **The constitution and rate of growth of a tropical moist deciduous forest in South Chanda Division, Madhya Pradesh**. Indian Forester 81(10): 604-619.

It is shown that like the tropical wet evergreen Ghat forests, balanced uneven aged crops belonging to the moist deciduous forest type obey the law of de Liocourt. The basal area and volume per acre of the growing stock and their rates of growth have been determined and compared with those resulting in the tropical wet evergreen type and teak and sal even aged crops of comparable site quality. The average rates of diameter growth of the 17 commonest tree species have been determined and are presented.

3422 Mauricio, J.R; Vincent, L; Moret, A.Y. 1999. **A competition model for the teak plantations in the experimental area of the Caparo Forest Reserve (Barinas-Venezuela)**. (Spanish). Revista Forestal Venezolana 43(2): 157-171.

The crown diameter - diameter at breast height relationship was fitted to a potential model, using non-linear regression.

Periodic increments in dbh were predicted using linear and non-linear regression with Bella's model functions as explanatory variables. The non-linear model was the best predictor for 3-year periodic increments in dbh.

3423 Mein, A.J. 1885. **Dimensions of a teak tree**. Indian Forester 11: p376.

Gives the growth figures of a teak tree sown at Kulsi, Assam in 1874 and cut down in 1885.

3424 Mendoza, B; Alfonso, M; Fuenttes, D; Hugo, V. 1996. **Report of five years of growth of mahogany, cedar and teak in a plantation of Tezonapa, Veracruz**. Proceedings of Scientific and Technological Meeting of Forestry, Agriculture and Husbandry, Mexico 1996: 38-39.

3425 Miller, A.D. 1969. **Provisional yield tables for teak in Trinidad**. Government Printer, Trinidad and Tobago: 12p.

Yield table is provided of the Trinidad teak plantations for over 50 years. The method used in compiling the tables are described. The tables prescribed thinning regimes which are heavier than those currently practised and there is a discussion on how this may help to reduce site deterioration due to fires and erosion. The question of planting spacing is discussed and economic factors are mentioned.

3426 Miller, W.A. 1916. **Complete volume analysis of teak from Kirwatti jungles**. Indian Forester 42(8): 420-424.

Volume and increment have been worked out for these forests of teak. The author is of the opinion that the selection system that followed is most unsuited to these forests. Suggested a rotation of 80 years. He concludes the present high forest system is unsuitable and full limit of working is not reached. He recommends even-aged forest conversion under uniform system.

3427 Mohya, T. 1966. **Study on the correlation of width of crown, dbh and height of teak in 6-20 year old plantations**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Crown diameter, d.b.h. and height are correlated to their age.

3428 Moor, H.W. 1922. **Rate of growth of teak for Trinidad**. Indian Forester 48(11): 614-615.

Commenting on exotic origin of teak in Trinidad - 9 years ago, teak is considered faring well, under exotic conditions-except for a single reported case of boring by an unidentified beetle which has lead to a secondary attack by the fungus. Tabulated the data of growth which indicate girth and height of plantations.

3429 Mora Garces, A; Moret, A.Y. 2001. **An evaluation of estimation methods to fit volume equations for teak (*Tectona grandis* Linn.f.) plantations**. (Spanish). Revista Forestal Venezolana 45(2): 185-189.

A free distribution estimation method, non-linear estimation and Least squares were used to fit data from 174 trees selected by stratified sampling, considering diameter classes as strata. The results suggest that the simple allometric model can be estimated by nonparametric methods, Theil and Least square with log transformation in data.

3430 Morataya, R; Galloway, G. 1998. **Relationships between foliage and sapwood in *Tectona grandis* and *Gmelina arborea*: Applicability of the Pipe Model Theory and silvicultural implications**. Revista Forestal Centroamericana 7(22): 21-28.

This study demonstrates the importance of thinning by examining the relationships between sapwood and foliage biomass in *Tectona grandis* and *Gmelina arborea* and evaluating the applicability of the Pipe Model Theory to these species. The Pipe Model Theory was found to be applicable to both species. The results indicate that it is important to favour tree crown development without permitting premature crown recession if the aim is to produce saw timber in established stands.

3431 Morataya, R; Galloway, G; Berninger, F; Kanninen, M. 1999. **Foliage biomass-sapwood (area and volume) relationships of *Tectona grandis* Linn.f. and *Gmelina arborea* Roxb: Silvicultural implications**. Forest Ecology and Management 113(2/3): 231-239.

Foliage biomass and sapwood relationships were developed for *Tectona grandis* and *Gmelina arborea* growing in the Guanacaste province of Costa Rica. Strong linear relationships confirmed the applicability of Shinozaki's pipe model theory to both of these species. The relationships between foliage biomass and sapwood area and volume of the previous year's growth ring were also analysed and were found to be highly significant for *T. grandis*.

3432 Moret, A.Y; Jerez, M; Mora Garces, A. 1998. **Development of volume equations for**

plantations of teak (*Tectona grandis*) in the Experimental Unit of Caparo Forest Reserve, Barinas, Venezuela. (Spanish). Revista Forestal Venezolana 42(1): 41-50.

Fifteen regression models were developed using data from 174 trees, selected by stratified random sampling for diameter class, in order to obtain volume equations for teak plantations in Venezuela.

3433 Mungkorndin, S. 1968. **Teak yield regulation**. Master's Report, Colorado State University, Colorado: 57p.

3434 Murugesh, M; Balaji, B; Krishnan, S.R; Srinivasan, V.M; Balaji, S. 1998. **Use of linear measurement in the estimation of leaf area of teak (*Tectona grandis* Linn.f.)**. Indian Journal of Forestry 21(4): 363-365.

A method is described for estimating the leaf area of teak using the product of length and breadth multiplied by a constant. The value of the constant was derived by dividing the actual leaf area by length and breadth.

3435 Murugesh, M; Srinivasan, V.M; Rai, R.S.V; Balaji, S. 1997. **Growth and yield of teak (*Tectona grandis* Linn.f.) under irrigated condition**. Indian Journal of Forestry 20(4): 373-376.

A study was carried out in Tamil Nadu on the growth and yield of teak in three irrigated woodlots at different sites. Data are tabulated on growth parameters and current annual increment and mean annual increment for dbh and height at each age. Based on this, the volume at 20 yr is extrapolated to be 7.00 ft3/tree.

3436 Nadagouda, V.B; Patil, C.V; Desai, B.K; Manjappa, K. 1997. **Growth and yield of seven tree species under high density planting and irrigation**. Indian Forester 123(1): 61-65.

The performance of seven tree species including *Tectona grandis* under high density planting was evaluated on irrigated red sandy clay loam soils in Karnataka. At the end of the fifth year, *Tectona grandis* had the lowest wood yield of 28.1 t/ha.

3437 Nair, C.T.S. 2000. **An introduction to technology and productivity issues**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 1-10. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

Broad features of identified production systems i.e., natural forests, plantations and small scale plantings especially in homegardens and small woodlots are discussed. The variation of each system from country to country and the history of its management are discussed. The spatial and temperal changes in teak planting are also summarised. Impact of technology on productivity of teak plantations and marketing and utilisation of teakwood in different production systems are discussed. Objectives of the International Seminar on site, technology and productivity of teak plantations are also discussed.

3438 Nataraja, K.N; Arun Kumar, A.N; Srivastava, A. 2003. **A non destructive method for estimation of leaf area in nursery grown teak (*Tectona grandis* Linn.f.) seedlings**. Annals of Forestry 11(1): 94-97.

3439 National Taiwan University. 1974. **Growth records of important species in the Experimental Forest, College of Agriculture, National Taiwan University**. (Chinese). Experimental Forest of National Taiwan University 4: 473p.

Tabulated data from permanent plots in plantations including *Tectona grandis* of Central Taiwan of stand increment and yield and of very detailed stem analyses at different ages are presented.

3440 Nayak, P.K; Senapati, S.C. 1998. **Evaluation of tree species under various plant geometry**. Environment and Ecology 16(2): 382-384.

In a field experiment in Orissa, 6-month-old seedlings of *Tectona grandis* and other species were planted at different spacings. Tree height was found the highest with the close spacing of 1 m X 1 m, while girth at breast height was the highest with the wide spacing of 4 m X 2 m, in all the species.

3441 Negi, G.S. 1967. **The accuracy of basal area increment with increment borer**. Indian Forester 93(6): 377-382.

It is estimated that the precision and accuracy of basal area increment based on borings varied with the tree species including teak.

3442 Negi, J.D.S; Bahuguna, V.K; Sharma, D.C. 1990. **Biomass production and distribution of nutrients in 20 years old teak (*Tectona grandis*) and gamar (*Gmelina arborea*) plantations in Tripura**. Indian Forester 116(9): 681-686.

Estimates based on the mean tree technique are presented from teak and *Gmelina arborea* plantations that had been established on land reclaimed from shifting cultivation. Average tree density, diameter, height and mean annual increment are presented. Total above-ground biomass and annual productivity for both the species are also presented.

3443 Negi, M.S; Dhiman, R.C. 2000. **Biomass estimation of teak plantation from Terai Region of Uttar Pradesh**. Indian Journal of Soil Conservation 28(2): 151-159.

Results of a study conducted in teak plantations in Uttar Pradesh in observing growth and biomass parameters of height, diameter at breast height (dbh) and volume of mean tree, are presented and discussed. Regression equations were developed for predicting biomass and growth of different tree components based on age and dbh.

3444 Negi, M.S; Tandon, V.N; Rawat, H.S. 1995. **Biomass and nutrient distribution in young teak (*Tectona grandis* Linn.f.) plantations in Tarai region of Uttar Pradesh**. Indian Forester 121(6): 455-464.

Estimates of dry matter production and nutrient distribution in 10-, 20- and 30-yr-old teak plantations are made using linear regression analysis. It is found that the diameter at breast height gave reasonably precise values of biomass and can be used for prediction purposes. The total standing biomass of the stands increased with increasing age and diameter.

3445 Neumann, A; Neumann, A.J. 1988. **Compendium of Solomon Island volume equations for plantation species**. Forestry Division, Solomon Islands, Forest Research Note 41-9-88: 14p.

Equations based on data collected from felled trees and relascope measurements are summarized for seven species including *Tectona grandis*.

3446 Nguyen Hoang Nghia; Booth, T.H. 1996. **Current methods and future needs for tree growth prediction in Vietnam**. Matching trees and sites: Proceedings of an International Workshop, Bangkok, Thailand, 27-30 March 1995: 65-67; ACIAR Proceedings 63. Australian Centre for International Agricultural Research, Canberra, Australia.

The VIET climatic mapping program is suggested for finding where particular species and provenances can grow. The paper includes data on the growth of species including *Tectona grandis* at sites in Vietnam, in relation to soil and water requirements.

3447 Nimitsiriwat, S. 1966. **Comparison of the measurement of dbh of teak using different instruments**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The efficiency of different instruments used for measuring diameter at breast height are compared which are of caliper, diameter tape, Biltmore stick and Bitterlich caliper.

3448 Nisbet, J. 1898. **On largest logs of teak**. Indian Forester 24: p320.

The log cut from Shweli forests was of 82 ft. length, basal girth of 12-13 ft. and top girth of 7-8 ft. and a volume of 516 cft.

3449 Nunifu, T.K; Murchison, H.G. 1999. **Provisional yield models of teak (*Tectona grandis* Linn.f.) plantations in northern Ghana**. Forest Ecology and Management 120(1/3): 171-178.

The paper presents the results of a preliminary investigation into the growth and yield of teak in northern Ghana. Data were collected from plots from plantations ranging in age from 3 to 40 yr, are used to develop a standard volume equation, site index curves and provisional empirical yield tables.

3450 Nwoboshi, L.C. 1983. **Growth and nutrient requirements in a teak plantation age series in Nigeria. 1. Linear growth and biomass production**. Forest Science 29(1): 159-165.

Linear dimensions and aboveground biomass accumulation and distribution were measured for 40 trees of age 1-5 yr. Variations in average dbh, height, basal area, volume, leaf area index, diameter production, rate of biomass accumulation and leaf biomass with age are studied. It is recommended that thinning should be started in 9- to 11-yr-old stands, when LAI reaches about 4.5.

3451 Ola-Adams, B.A. 1974. **Estimation of biomass and productivity of some natural forests and plantations in** Nigeria**.** Nigerian Journal of Forestry 4(1): 18-23.

Data estimated from measurements of wood volume and oven-dry specific gravity are presented. Estimated values for biomass of natural forests, forest plantations including teak and savanna plantations are given. The estimated mean annual accumulations of organic matter for forests and savanna plantations are also given.

3452 Ola-Adams, B.A. 1997. **Assessment of three allometric regression techniques of biomass determination in two hardwood species**. Journal of Tropical Forest Science 9(3): 321-328.

Biomass estimations using three allometric regression equations with different independent variables were carried out in 18-yr-old *Tectona grandis* plantations established at SW Nigeria.

3453 Oliver, J.W. 1882. **Rate of growth of teak in Burma**. Indian Forester 9: p440.

Compares the true and false rings occurring on teak and concludes that true growth rings are annual.

3454 Oza, M.P; Srivastava, V.K; Devaiah, P.K. 1992. **Estimating the mean canopy diameter of teak plantations from Landsat MSS data**. International Journal of Remote Sensing 13(12): 2363-2369.

An attempt has been made to estimate mean canopy diameter in managed even-aged teak plantations in Karnataka using Landsat-4 Multispectral Scanner data. Mean canopy diameter of plantations of different ages ranging from 4 to 63 yr were measured. Variables entering regression equations were selected by the leaps and bounds technique.

3455 Pandey, D. 1983. **Growth and yield of plantation species in the tropics**. FAO, Rome.

3456 Pandey, D. 1996. **Estimating productivity of tropical forest plantations by climatic factors**. Rapport Institutionen for Skoglig Resurshushallning och Geomatik, Sveriges Lantbruksuniversitet 7: 82p. Institutionen for Skoglig Resurshushallning och Geomatik, Department of Forest Management and Geomatiks, Swedish University of Agricultural Sciences, Sweden.

The study reviews the existing approaches available for estimating growth and yield of plantation species in the tropics. A generic model is formulated for estimating potential yield of plantation species in the tropics using climatic variables. The quantitative relation between individual climatic variables and potential yield of plantation teak was studied.

3457 Pandey, D. 1996. **Tropical forest plantation resources: Assessment of extent and methods for yield estimation**. Acta Universitatis Agriculturae Sueciae Silvestria 11: 47p. Swedish University of Agricultural Sciences, Umea, Sweden.

The role of tropical forest plantations in economic development and in reversing deforestation in tropical countries is discussed. The development of plantations over time is described and the general trend in tropical plantation forestry in recent years is critically analysed. A generic model for estimating potential yield by climatic factors was developed using teak. Recommendations for realising the potential value of tropical plantations and future assessment are presented.

3458 Pandeya, S.C; Kuruvilla, K. 1967. **Net production relations of five important tree species at Waghai range of Dangs forests, Gujarat**. Proceedings of Indian Academy of Sciences 66B(1): 25-36.

It is found that stem volume, gbh, total dry weight and height are directly proportional to number of growth rings, total dry weight increases with increasing g.b.h., distribution of net annual productivity shows increasing concentration of growth in woody tissues with increasing plant size in species including *Tectona grandis*.

3459 Perez, C.L.D; Kanninen, M. 2002. **Estimation of the commercial volume to diameters and variable heights for *Tectona grandis* Linn.f. in Costa Rica**. Revista Forestal Centroamericana 39-40: 56-59.

Volume equations which predict individual tree volume and merchantable volume for teak in Costa Rica is tested.

3460 Petekhandah, S. 1965. **Study on the relationship of crown widths and root spreads of teak in teak plantations of different ages**. (Thai). Student Thesis. Kasetsart University, Bangkok.

No relationship was observed between crown spread and root spread in teak plantations of 1-20 years age observed.

3461 Petmark, P; Sahunalu, P. 1978. **Primary production of teak plantations. I. Net primary production of thinned and unthinned plantations at Ngao, Lampang**. (Thai). Faculty of Forestry, Kasetsart University, Forest Research Bulletin 53: 76p.

Data on above ground biomass, net primary production, stem volume increment and leaf efficiency in production from 14-yr-old stands thinned at 8 yr old by removing 45 percent basal area is given.

3462 Phang-Sono. 1977. **Study on teak stumps to ascertain volumetric index for duty collection**. (Thai). Vanasarn 35(4): 451-463.

3463 Phillips, G.B. 1995. **Growth functions for teak (*Tectona grandis* Linn.f.) plantations in Sri Lanka**. Commonwealth Forestry Review 74(4): 361-375.

The paper briefly reviews the current practices in teak silviculture in Sri Lanka and outlines the need for growth and yield models. Describes the development of growth functions for dominant height and cumulative basal area and a growth and yield model developed using the Excel spreadsheet.

3464 Phong-Amphai, S. 1965. **Study on the growth of teak in the teak plantations of Lampang and Nakorn, Rajsima**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The growth of teak plantation of Klangdong and Mae Huad are compared.

3465 Phukphan, S. 1965. **Increment of teak of different qualities**. (Thai). Student Thesis. Kasetsart University, Bangkok.

There is least significant difference in diameter growth and girth of teak in different quality sites.

3466 Pinol, A.A. 1994. **Yield prediction models for teak (*Tectona grandis* Linn.f.)**. Sylvatrop 4(1): 65-80.

Yield prediction functions for both merchantable and sawn timber yield for teak plantations were derived from plots by regression analysis. The plots represented a wide range of site qualities, stand densities and ages of teak in the Philippines. A site index guide equation and plot site index equation at 40-years base age were developed.

3467 Pongsopha, Ch. 1965. **Study on the productivity of teak in 20 years old teak plantation**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The study establishes a significant correlation between d.b.h. stem weight, branch weight, leaf weight and whole tree weight.

3468 Powell, W.S. 1923. **Note on the growth of teak and teak plantations in Arakan Burma**. Burma Forest Bulletin (Silviculture) 8: 1-43.

Financial results obtained indicate profitability of growing teak plantations. Taungya method was followed in later plantation to reduce costs.

3469 Prasad, R; Mishra, G.P. 1984. **Standing biomass of various plant parts in selected tree species of dry deciduous teak forest in M.P**. Indian Forester 110(8): 765-782.

An investigation was made in the teak forests in Madhya Pradesh, to correlate their biomass productivity with various plant parameters and age, utilizing wind-fallen teak trees and felled trees of other species. The crown, stem, and root biomass of these species is tabulated against girth and age.

3470 Prasoon Kumar; Mohan Kumar, B. 1997. **Density management diagram - a novel approach in stand density manipulation of teak plantations**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 61-67. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

A density management diagram to predict and display the likely consequences of teak stand manipulation on stand growth and yield was constructed using the inventory data collected from the teak plantations of Kerala. Use of this diagram in maximization of individual tree growth and stand growth is also demonstrated.

3471 Prertiwarakul, L. 1968. **Correlation of growth between crown diameter and width of annual rings of teak of different age classes at Huay-Tak teak plantation, Lampang**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Teak plantations of 5, 10, 15 and 20 years were studied and found that the increment of crown diameter and width of annual rings are significantly correlated with the periods.

3472 Priya, P.B. 1998. **Growth periodicity and juvenile wood formation in teak**. Ph.D Thesis: 154p. Forest Research Institute, Deemed University, Dehra Dun.

3473 Prommool, S. 1962. **The correlation between crown diameter and dbh, crown diameter and height and dbh and height of teak at Mae Huad forest, Lampang**. (Thai). Student Thesis. Kasetsart University, Bangkok.

A significant correlation was observed in natural forest between crown diameter, height and dbh in the study.

3474 Purwanto, R.H; Oohata, S. 2002. **Estimation of the biomass and net primary production in a planted teak forest in Madiun, East Java, Indonesia**. Forest Research, Kyoto 74: 59-68.

The biomass and productivity of planted teak forests in old stands of 10- to 40-year-old were estimated and compared with those of young stands. The allometric relationships of various dimensions of individual trees e.g. stem diameter at breast height and stem diameter at the lowest branch DB were estimated. The productivity was estimated using the biomass increment and leaf production.

3475 Raghavan, M.S. 1946. **Constants connecting top heights and age for different site qualities in teak plantations**. Indian Forester 72(10): 460-461.

A formula is shown to define the height age curvilinear relationship in the yield table for plantation teak.

3476 Rajkhowa, S. 1970. **The shape of a teak tree**. Indian Forester 96(1): 719-731.

Relations of tree height, tree diameter and crown spread were calculated for *Tectona grandis* of three quality classes. Regression equations for estimating bole diameter and equations relating bole diameter to tree height and crown spread are tabulated, and their degrees of fit are estimated for the three quality classes.

3477 Ram, B.S. 1942. **Standard and commercial volume tables for teak (*Tectona grandis*, Linn. F.) in the Central Provinces**. Indian Forest Records (n.s.) Silviculture 4-A(3): 145-169.

Volumes calculated by basal-area and quarter-girth measurements are given for various diameter and height and girth and height classes.

3478 Rao, R.V; Shashikala, S. 2003. **Assessment of growth rate, basic density and heartwood content in selected teak clones of CSO, Thithimathi, Karnataka**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

An attempt was made to generate data and understand the variation in wood quality in individual trees which can be used subsequently for the purpose of selection for seed collection as well as mass propagation. Trees representing clones from Haliyal, Thirthimathi, Shimoga, Kakanakote, Nagarahole and Bhadravathi were subjected for investigation.

3479 Ratanakoses, S. 1964. **Correlation between basal area and age of teak in Huay-Tak teak plantations of different age classes**. (Thai). Student Thesis. Kasetsart University, Bangkok.

A correlation was found in the study between age class of 5-20 years and basal area.

3480 Rawat, A.S. 1954. **Mathematical equation for determining the stem timber form factor of *Tectona grandis***. Indian Forester 80(9): 513-521.

A formula has been worked out for determination of form factor of *Tectona grandis* trees of different dimensions and age growing under different locality conditions to provide a method by which volume of standing trees can be estimated from the measurements of dbh and tree heights.

3481 Reddy, C.J. 1995. **The bounty from the teak tree**. Indian Forester 121(6): 573-575.

A brief discussion of the very high potential growth rates of teak plantations in India and of their profitability and wood quality.

3482 Renes, G.J.B. 1978. **An investigation of yield and productivity of teak plantations in South-Western Nigeria**. Federal Department of Forestry, Ibadan, Nigeria.

3483 Rodger, A. 1923. **The biggest teak log ever brought out from the forests of Burma**. Indian Forester 49(2): p80.

Reports of a big teak log extracted from Shweli Valley, Ruby mines district, Burma is having the size of 82.5 feet long, 10' in mid girth with 391 cft.

3484 Rogers, C.G. 1918. **Big teak in Burma**. Indian Forester 44(9): 416-419.

An account of the site factors such as geology, rock and soil, rainfall, character of the vegetation and altitude is given. Dimensions of five big trees are also given.

3485 Ross, J.K. 1954. **Yield of poles and fuelwood from Olokemeji reserve plantations (10 years rotation-coppice regeneration)**. Information Bulletin of Forest Department, Nigeria 14(2/3).

Included mainly teak.

3486 Roy, P.S; Singh, I.J; Das, K.K; Sharma, C.M; Hyderi, S.A. 1996. **Growing stock estimation of monoculture plantations using remote sensing techniques and a geographical information system - a case study in central Tarai Forest division, U.P**. Proceedings, IUFRO-DNAES International Meeting: Resource inventory techniques to support agro forestry and environment, Chandigarh, 1-3 October 1996: 73-83. B.K. Quershi; R.K. Kohli; K.S. Arya; Atul, Eds. HKT Publications, Chandigarh.

Results are given of a case study carried out in the Central Tarai Forest Division of Uttar Pradesh using inventory data, Landsat Thematic mapped data and a geographical information for the area. The area is mainly consist of teak plantation with some mixed plantations.

3487 Rugmini, P; Balagopalan, M. 2001. **Growth of teak in successive rotations: A case study at Nilambur, Kerala, India**. Tropical Forestry Research: Challenges in the New Millennium. Proceedings of the International Symposium, Peechi, India, 2-4 August 2000. R.V. Varma; K.V. Bhat; E.M. Muralidharan; J.K. Sharma, Eds: 192-194. Kerala Forest Research Institute, Peechi.

A study on growth of teak in successive rotations was carried out at Nilambur, Kerala. The decrease in tree height and dbh from first rotation to later rotations and from plain lands to hilly terrain for plantations of same age and stocking indicated loss of tree vigour with successive rotations and sloping terrains.

3488 Sagreiya, K.P. 1956. **Brandis' method of yield regulation**. Indian Forester 82(6): 271-285.

Gives a mathematical analysis of Brandis' system, applies it to a Madhya Pradesh forest containing 25 percent teak.

3489 Sagreiya, K.P. 1958. **Fixation of the yield of an irregular forest on the basis of its current annual increment**. Indian Forester 84(4): 213-215.

Deals with the comparative merit of the author's method and Sahai's method of calculation with reference to Smythies' formula in determining the correct yield.

3490 Sagreiya, K.P. 1963 . **Single stem silviculture (height/spacing relationship)**. Indian Forester 89(10): 652-656.

Discusses criticisms of the author's proposal to use the normal N/D correlation of teak in determining thinning schedules and proposes instead the relationship of stand density to height.

3491 Sagreiya, K.P; Chacko, V.J. 1962. **A statistical approach to models for yield tables in even aged teak forests and some applications**. Indian Forester 88(12): 896-906.

Site quality index for even-aged teak forests based on top height is defined, and a method of determining the site quality is explained. Three equations giving the top height corresponding to a site quality and age, normal diameter corresponding to a top height, and normal number of trees per acre given the mean diameter are presented. These three equations summarize the yield table for even-aged teak forests.

3492 Saing, T.K. 1928. **Biggest Teak tree in Burma**. Indian Forester 54(7): 423-424.

Reports log yield from a big teak with girth at base 29'3" at 4.5'-25'11" on felling and 26'7" at girdling time, yielded over 14 logs of 1367 cft.

3493 Samantakul, V; Songkul, S. 1995. **Teak resources in Thailand. Teak for the future**. Proceedings of the 2nd Regional Seminar on Teak, Yangon, Myanmar, 29 May-3 June 1995.

3494 Samapudhi, K. 1966. **Forestry development in Thailand**. Royal Forest Department, Bangkok: 39p.

A general note on forests, forestry, management, policy wildlife, National parks and administration etc. The forests area managed for teak extraction in Thailand is 115, 632 sq.km. and teak plantation raised and old giant teak logs extracted are illustrated.

3495 Samranchit, T. 1964. **Comparison of the Survival percentage and growth of teak in the second year from plants resulting from special problem No. 75, 86 and 89**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Height growth and survival of stump with roots is found better than those without roots. Expenditure of stumps without root is found also higher. Stored stumps are better than fresh ones. Height growth of unforked stump is found better than forked stumps, but survival of forked stumps is better.

3496 Sandrasegaran, K. 1966. **Provisional local volume tables for teak (*Tectona grandis* Linn.f.)**. Malaysian Forester 29(1): 39-40.

The data from Perlis, N.W. Malaya gives in cubic feet fuel tree volume and total small wood volume.

3497 Sandrasegaran, K. 1969. **A general volume table for *Tectona grandis* Linn.f. (teak) grown in north-west Malaya**. Malaysian Forester 32(2): 187-200.

A volume table is given based on a multiple regression analysis by computer of more recent data, with an account of the statistical method.

3498 Santhadkaran, P. 1964. **Percentage of well formed trees found in various age classes of Mae Huad teak plantation, Lampang**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The well formed tree percentage was reported as between 58 to 83 which is highly variable.

3499 Shende, N.V; Atkar, R.B; Shende, T.K. 1998. **Resource productivity and input use efficiency of major forest crops grown by farmers under Akola district**. Economic Affairs Calcutta 43(1): 28-32.

Examined the productivity and efficiency of inputs used in production by applying a Cobb-Douglas production function equation. Variables examined are tree crop yield, area under the crop, human labour days, bullock labour days, value of seedlings, expenditure incurred on manures and fertilizers, irrigation on plantation, expenditure on plant protection.

3500 Shirley, G.S. 1928. **Volumes of single trees and volume and number of trees per acre from data collected in teak (*Tectona grandis*) plantations in Burma**. Burma Forest Bulletin 17 (Silviculture Series 13).

3501 Shirley, G.S. 1932. **Rate of growth of teak in Burma**. Annual Report of Working Plans etc, Burma: p52; 54.

3502 Singh, A.K. 1978. **Comparison of primary productivity and energetics of Savanna and teak (*Tectona grandis* Linn.f.) plantations at Chandraprabha Region, Varanasi**. Thesis. Banaras Hindu University, Varanasi.

3503 Singh, A.K; Gupta, B.N. 1993. **Biomass production and nutrient distribution in some important tree species on Bhata soils of Raipur (Madhya Pradesh), India**. Annals of Forestry 1(1): 47-53.

Biomass production and nutrient distribution in the different components of six tree species including *Tectona grandis* were studied in plantations of different ages. Nutrient content was higher in the leaves and lower in the roots of all species.

3504 Singh, A.K; Pandey, V.N; Misra, K.N. 1980. **Stand composition and phytomass distribution of a tropical deciduous teak (*Tectona grandis*) plantation in India**. Journal of the Japanese Forestry Society 62(4): 128-137.

Measurements of girth at 1.3 m. height, crown circumference and length, density and basal area were made in five permanent plots. A phytosociological study of the ground vegetation was made. Biomass was estimated in the tree layer by felling 3 trees from each girth class and excavating the underground parts. Significant correlations were found between logarithmic values of girth and of other measurements like height, crown length and circumference and total tree biomass.

3505 Singh, M.M. 1967. **Growth of teak in Nilambur and Wynaad divisions, Kerala State and applicability of yield tables**. Proceedings of the 11th Silvicultural Conference, Dehra Dun, 1967 Item II. Forest Research Institute, Dehra Dun.

The growth from sample plots in Nilambur and Wyanad divisions of Kerala state is studied. It is found that the crops in Nilambur Division are generally of 1st quality and in Wyanad of 2nd. From growth studies on sample plots the applicability of yield tables is discussed.

3506 Singh, S.B. 1981. **Linear programming for determining quantitative composition of species in a mixed plantation**. Indian Forester 107(11): 686-692.

Linear programming in conjunction with the Simplex method were used to develop a model for determining optimal species composition, growth and stumpage value of each species and constraints such as area, supply commitments and management costs.

3507 Singh, S.P. 1981. **Total tree volume table for *Tectona grandis***. Indian Forester 107(10): 621-623.

Tables of total tree standard timber volumes are given based on data for 660 trees from Madhya Pradesh, Maharashtra, Karnataka, Tamil Nadu, Kerala, Andhra Pradesh, Orissa, West Bengal and Uttar Pradesh.

3508 Singhal, P.C; Trivedi, B.K. 2001. **Comparative growth dynamics of some indigenous and exotic forest tree species**. Range Management and Agroforestry 22(1): 130-133.

The growth dynamics of seven forest tree species including *Tectona grandis* were studied in Jhansi, Uttar Pradesh.

3509 Siswamartana, S. 2000. **Productivity of teak plantations in Indonesia**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 137-144. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

Reviews teak management in Indonesia and discusses factors influencing its productivity.

3510 Soemaatmadja, S.A.S. 1982. **Correlation between age and diameter in Java's teak forests**. (Indonesian). Duta Rimba 8(53): 18-32.

3511 Soemarna, K. 1979. **The enumeration method of border plots in sampling for the estimation of standing stock of teak**. (Indonesian). Laporan, Lembaga Penelitian Hutan 314: 23p.

3512 Soemarna, K; Barizi; Nasoetion, A.H; Sudiono, Y. 1977. **Estimation of basal area and number of trees in teak (*Tectona grandis*) stands**. (Indonesian). Forum, Sekolah Pasca Sarjana, Institut Pertanian Bogor 1(2): 17p.

A study of sampling methods in two 40- to 50-yr-old stands showed that the best method was plot sampling.

3513 Sono, P. 1967. **A remarkable growth of teak grown in Eastern Thailand**. Vanasarn 25(4): 285-288.

Teak is considered as a fast growing species based on growth data studies, especially when planted in Eastern Thailand, it is hoped to give good economic returns.

3514 Sono, P. 1975. **Exploitable girth limit for teak**. Vanasarn 33(2): 151-159.

Presents two growth curves for natural *Tectona grandis* in Thailand and gives sociological, economic and technological reasons for concluding that the present girth limit of 213 cm should be reduced to 150 cm.

3515 Sono, P. 1975. **Sono method of analysis for teak growth in Thailand**. (Thai). Vanasarn 33(4): 389-397.

3516 Sono, P. 1978. **Growth rate of teak in Huai Thak Plantation, Ngao, Lampang Province as determined by stump analysis for teak reforestation in 1978**. (Thai). Proceedings of the 1978 National Forestry Conference: 146-155. Royal Forest Department, Ministry of Agriculture and Cooperatives, Bangkok.

3517 Soonyakhanit, S. 1963. **Correlation between diameter, bark thickness and sapwood thickness at breast height of teak**. (Thai). Student Thesis. Kasetsart University, Bangkok.

A measurement of diameter, bark thickness and sapwood thickness at breast height of dominant, codominant, intermediate and suppressed classes of each 25 trees, gave a highly significant correlation between diameter and bark thickness.

3518 Sowani, M.Y; Gadkari, R.K. 1977. **Yield and stand tables for plantation teak (*Tectona grandis* Linn.f.) in metric units**. Maharashtra Forest Records (Silviculture) 1. Forest Development Corporation of Maharashtra, Nagpur.

3519 Sprinz, P.T. 1974 . **Form class, standard and local volume tables for teak (*Tectona grandis*) in Ghana**. Forest Products Research Institute, Ghana, Technical Note 20: 53p.

3520 Srivastava, V.K; Rai, A.M; Dixit, R.K; Oza, M.P; Narayana, A; Murty, E.S. 1998. **Significance of tree crown diameter in forest mensuration**. Indian Forester 124(12): 1001-1009.

Data collected from teak and sal plantations and natural forests shows that mean crown diameter is significantly correlated with mean tree volume. Regression equations were developed for the relationship and their predictive performance was evaluated.

3521 Stoutjesdijk, J.A.J.H. 1925. **Comparison of yield table data on teak in British India and the Netherlands East Indies**. (Dutch; English). Tectona 18: 1043-1075.

Bourne's yield tables for Nilambur teak are compared with that of Beekman for Margasri, Central Java. Age of sample plot used for both, but Bourne used top height, while Beekman used mean height. The low number of stems at 40 years in Nilambur is attributed to heavier thinnings. Stem wood and crown wood comparisons are also made.

3522 Stoutjesdijk, J.A.J.H. 1927. **Volumetric tables for natural teak forests**. (Dutch; English). Tectona 20(9): 729-780; Korte Meded Proefsta Boschw, Buitenzorg 13: 1-54.

3523 Subramanian, K; Mandal, A.K; Rambabu, N; Mammen, C; Nagarajan, B. 2000. **Site, technology and productivity of teak plantations in India**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 51-68. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

The first teak plantations was established in 1846 and large scale commercial cultivation of teak was taken up during the 1960's. Private companies started to invest in teak plantations in India since 1990. Most plantations were raised as industrial plantations between 1950 and 1970 under the schemes of the national five year plans. Improved technologies adopted to intensify management via increased inputs and silvicultural practices to achieve higher productivity are discussed in detail. It is suggested that the productivity of teak in India can be improved by identifying seed production areas, selecting more plus trees and clonal seed orchards and hybridization programs within and between species. The transfer of desirable genes for particular traits can increase productivity.

3524 Sudarmo, M.K. 1957. **Mensuration, yield and increment in Indonesia**. FAO/Teak Sub-Commission, Bandung FAO/TSC-57/23: 8p. FAO, Rome.

Notes on methods used for selecting and delimiting sample plots, description of trees by crown class, crown form and stem form for measurement of height diameter, basal area, volume, increment etc. are given.

3525 Sudhakara, K; Jayamadhavan, A; Wahid, P.A. 2001. **Mean tree volume and basal area in teak (*Tectona grandis* Linn.f.) as influenced by nutrient concentration of index leaves**. Tropical Forestry Research: Challenges in the New Millennium. Proceedings of the International Symposium, Peechi, India, 2-4 August 2000. R.V. Varma; K.V. Bhat; E.M. Muralidharan; J.K. Sharma, Eds: 115-119. Kerala Forest Research Institute, Peechi.

Leaf samples of teak from four site qualities at Nilambur, Kerala were analysed for foliar N, P and K concentrations to determine the critical nutrient levels. Equations were fitted to find the relationship of tree volume and basal area based on foliar nutrient concentration. The study help to get an insight into the silvicultural implications of fertilizer application.

3526 Sudheendrakumar, V.V; Nair, K.S.S; Chacko, K.C. 1993. **Phenology and seasonal growth trend of teak at Nilambur (Kerala), India**. Annals of Forestry 1(1): 42-46.

Leaf phenology and seasonal patterns of basal area increment of teak were studied in plantations protected from *Hyblaea puera* and *Eutectona machaeralis* in Karulai Range, Nilambur Forest Division. In general, flushing began in late March and was completed by late April. Most leaf fall occurred during December to February. The rate of increment of basal area followed a bell-shaped annual curve with most growth occurring in June, July, August and September. The results are discussed in relation to damage caused by *H. puera* and *E. machaeralis*.

3527 Sukwong, S. 1972. **Estimating past diameter of teak in Lampang**. (Thai). Forest Research Bulletin 20: 15p. Kasetsart University, Bangkok.

It is possible to estimate past diameter of teak with the help of tables presented in this paper. To use the table measurement at b.h. of diameter and radial wood growth for any specified period are required to calculate average annual width of rings. Tables are presented for natural forest and plantation grown teak separately and suggesting interpolation of data for use of tables wherever necessary.

3528 Sukwong, S; Kaitpraneet, W; Thaiutsa, B; Khemnark, C. 1974. **Predicting height growth of plantation teak from soil and topographic factors**. (Thai). Kasetsart Journal 8(2): 63-71.

3529 Sukwong, S; Tawee Kaewla iad. 1971. **Diameter conversion between stump and breast height for teak**. (Thai). Faculty of Forestry, Kasetsart University, Thailand, Research Note 4: 3p.

A multiple regression equation showed that there was a significant relationship between d.b.h. and stump diameter of teak in Lampang, Thailand. A method is given for determining the volume from the stump diameter.

3530 Sundarapandian, S; Chandrasekharan, S; Swamy, P.S. 1999. **Variations in fine root biomass and net primary productivity due to conversion of tropical forests into forest plantations**. Tropical Ecology 40(2): 305-312.

The changes in fine root biomass and net primary productivity following conversion of tropical forests into forestry plantations of teak and other species were studied at Kodayar in Western Ghats. The fine root biomass was significantly greater under the natural ecosystems compared to that of the monoculture plantations except in teak plantation. Similarly NPP was also greater in natural ecosystems compared with the plantations except teak plantations.

3531 Sundarapandian, S; Swamy, P.S; Box, J.E. 1998. **Variation in fine-root biomass and net primary productivity due to conversion of tropical forests into plantation crops and agroecosystems**. Root demographics and their efficiencies in sustainable agriculture, grasslands and forest ecosystems: Proceedings of the 5th Symposium of the International Society of Root Research, 14-18 July 1996, Clemson University, South Carolina: 369-382. Developments in Plant and Soil Sciences 82. Kluwer Academic Publishers, Dordrecht, Netherlands.

The changes in fine-root biomass and net primary productivity following conversion of tropical forests into forest plantations of *Tectona grandis* and other species and agro ecosystems were studied at Kodayar in Western Ghats. Root biomass and NPP were significantly altered in man-modified ecosystems. Very fine-root biomass and NPP were significantly greater in natural ecosystems when compared with monoculture plantations and agro ecosystems except in teak plantations.

3532 Suri, S.K. 1974. **Qualitative and quantitative analysis of teak saw logs of Bastar forests**. Indian Forester 100(8): 483-490.

An analysis of data from auctions at six major depots in the Bastar Circle showed that sawlogs of grades I, II and III constituted 16, 48 and 18 percent respectively of the total annual volume of teak sawlogs auctioned. Cumulative curves were constructed to show the volume distribution of girths and lengths of teak logs.

3533 Suri, S.K. 1975. **Correlation studies between bole diameter and crown projection area as an aid to thinning**. Indian Forester 101(9): 539-554.

Regression analysis of data of trees of *Cedrus deodara*, *Abies pindrow* and *Tectona grandis* in Kerala showed a positive correlation between stem diameter and crown projection area for each species. The curves of number of stems per acre over diameter as predicted by the regression equation and those taken from yield tables are compared for each species. The use of the relation between the two variables as a guide to thinning and initial spacing is described, and their value for aerial survey purposes is noted.

3534 Suri, S.K. 1984. **A suggested model for quantitative assessment of plantations with particular reference to Pakela teak plantations of South Bastar Division (M.P.)**. Indian Forester 110(3): 253-263.

From dendrometric data collected the plantations are assessed as All India Site Quality II. Growth Achievement Indices are arrived at by comparing actual diameter, height, stems, basal area and volume with the estimated yield table figures.

3535 Swe, M; Booth, T.H. 1996. **Site selection and growth prediction in Myanmar**. Matching trees and sites: Proceedings of an international workshop, Bangkok, Thailand, 27-30 March 1995: 71-76; ACIAR Proceedings 63. Australian Centre for International Agricultural Research, Canberra, Australia.

The Forest Department has an annual planting target of 80 000 acres in Myanmar. *Tectona grandis* and some other hardwood species are favoured on good sites. Computerized mensurational models have been built to predict growth in existing plantation and natural forests, but there is also a need for analytical method using climate and soil data to assist species and provenance selection.

3536 Tangtham, N. 1971. **Structure and growth of once exploited teak forest**. (Thai). Forest Research Bulletin 18: p81. Kasetsart University, Bangkok.

Study was carried out in teak forest exploited for 20-25 years. Size class structure of teak was analysed. Increment and growth studies were carried out on stems of teak.

3537 Tantangkul, Ch. 1968. **Teak stem analysis in Klangdong teak plantation**. (Thai). Student Thesis. Kasetsart University, Bangkok.

3538 Taschan, Ch. 1962. **Volume determination of teak branches**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Estimated the total volume of branch wood of the crown. A significant correlation was observed between crown wood volume and d.b.h. of the tree. The bark volume accounts for 16.26 percent of total tree volume.

3539 Tawee Kaewla iad; Chanchai Yarwudhi. 1975. **The estimation of the total amount of teak foliage**. (Thai). Faculty of Forestry, Kasetsart University, Thailand, Research Note 12: 11p.

The relations between number of leaves and total leaf surface area, total leaf weight, d.b.h. and total height were calculated for teak trees. Number of leaves was linearly correlated with each of the other characters; d.b.h. was better than total height for estimating the number of leaves.

3540 Tego Agbo Kangni, M. 1990. **Contribution to the elaboration of volume tables for teak in the coastal region and in the plateaux region (Togo)**. FAO F0 PNUD, FAO TOG 87 001, Lome, Togo: 18p.

3541 Tetuko, S.S.J; Tateishi, R; Wikantika, K. 2001. **A method to estimate tree trunk diameter and its application to discriminate Java-Indonesia tropical forests**. International Journal of Remote Sensing 22(1): 177-183.

A numerical method was used to analyse the interaction of L-band microwaves with the trunks of four species of Java-Indonesian trees including *Tectona grandis*. The horizontal polarization of the scattered wave was derived in order to calculate the relationship between tree trunk diameter and backscattering coefficient.

3542 Thaiutsa, B; Kaitpraneet, W. 1976. **The observation on ages, dbh and density of plantation teak at Huay Tak Teak plantation, Lampang**. (Thai). Faculty of Forestry, Kasetsart University, Thailand, Research Note 20: 12p.

On the basis of measurements in teak plantations of various ages, equations were developed to express the relations between d.b.h. and age, and between number of three per rai and d.b.h. or age. The equations were used as a guide for thinning.

3543 Thompson. 1927. **Growth of teak in Nigeria**. Forest Administration Report, Nigeria 1926-27: 16p.

3544 Thongma, Ch. 1965. **Effect of gamma radiation on the growth of teak**. (Thai). Student Thesis. Kasetsart, University, Bangkok.

After studying results with eight treatments, control and with radiation strengths of 1000 R, 1700 R, 3000 R, 4500 R, 6000 R, 8000 R and 10,000 R, the germination was found good for irradiation of below 6000 R strength and excess doses than this affected growth of stem and doses below 3000 R are not effective in accelerating growth rate.

3545 Tint, K; Schneider, T.W. 1980. **Dynamic growth and yield models for Burma teak**. Mitteilungen, Bundesforschungsanstalt fur Forst und Holzwirtschaft, Hamburg Reinbek 129: 93p.

A computer simulation model was developed for analysis of stand basal area and volume growth as functions of diameter class distribution and site class. Output consists of growth and yield tables of a natural teak selection forest in central Burma and for teak plantations giving stand statistics by 5-yr age intervals, including mensurational and yield data for main crop and thinnings, m.a.i. and c.a.i. Volume tables used in developing the model are given.

3546 Tireman, H. 1918. **Measurements of a teak tree**. Indian Forester 44(2): p86.

Records dimensions of a big teak tree in the forests of Southern Coorg. The girth of the tree at breast height was 25'2" and three logs of 562 cu. ft. were taken from the tree.

3547 Torres, F. 2000. **The potential teak in Brazil**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 145-150. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

Teak plantation programs in Brazil were initiated in 1971 with seeds from Trinidad provenance and Myanmar origin. Since then over 1,400 ha plantations have been established. An overview of the forests and the plantations of the country is provided.

3548 Unwin, R. 1937. **The yield in teak selection forests in Burma**. Indian Forester 63(6): 371-380.

Reports on yields and working of the system in Burma teak forests and suggestions are offered on fixation of yield specially in bamboo flowered areas.

3549 Vanclay, J.K; Skovsgaard, J.P; Hansen, C.P; Vanclay, J.K. 1995. **Assessing the quality of permanent sample plot databases for growth modeling in forest plantations**. Growth and yield estimation from successive forest inventories. IUFRO Conference, Copenhagen, 14-17 June 1993. Forest Ecology and Management 71(3): 177-186.

This paper illustrates graphical procedures to evaluate existing databases, to identify areas of weakness and to plan remedial sampling. Two graphs, one of site index versus age, another with stocking versus tree size provide a summary of the site and stand conditions represented in the database.

3550 Vasquez, C.W; Ugalde Arias, L.A. 1995. **Yield and site quality for *Gmelina arborea*, *Tectona grandis*, *Bombacopsis quinatum* and *Pinus caribaea* in Guanacaste, Costa Rica**. Serie Tecnica: Informe Tecnico Centro Agronomico Tropical de Investigacion y Ensenanza 256: 33p. Centro Agronomico Tropical de Investigacion y Ensenanza, Turrialba, Costa Rica.

The results are given of a study on site quality, variables influencing growth and yield, for the four species including teak, most used for reforestation in Costa Rica.

3551 Veillon, J.P; Silva, R. 1972. **Volume tables for standing trees and yield tables for forest plantations in Latin America**. (Spanish). 71p. Merida, Instituto Forestal Latinoamericano, Venezuela.

A compilation of 53 volume and yield tables giving data for several native species including teak arranged by regions.

3552 Vincent, A.J. 1964. **Plantation teak (*Tectona grandis* Linn.f.) sample plot Perlis No. 1 Mata Ayer forest reserve**. Malaysian Forester 27(2): 148-173.

Details are given of the stocking, growth, structural development and yield of a pure teak plantation. The relation between stem diameter, total height, mean crown diameter and crown freedom and their increments were examined. Crop was compared with yield table for teak plantations in India, Burma and Java.

3553 Vincent, L; Moret, A.Y; Jerez, M. 2000. **Comparative study of several stocking regimes in teak plantations at the Caparo Forest Experimental station, Barinas State, Venezuela**. (Spanish). Revista Forestal Venezolana 44(2): 87-95.

A comparative yield study from teak plantations with different stocking levels at the Caparo Forest Experimental Station, Venezuela is made. Plots with intensive thinning and wide spacing and moderate thinning with 4 x 4 m and thinning at age 13.8 years showed the greatest proportion of timber products.

3554 Wahyudi, I; Okuyama, T; Hadi, Y.S; Yamamoto, H; Watanabe, H; Yoshida, M. 2001. **Relationship between released strain and growth rate in 39 year-old *Tectona grandis* planted in Indonesia**. Holzforschung 55(1): 63-66.

3555 Waidarp, P. 1964. **The growth of teak heartwood**. (Thai). Student Thesis. Kasetsart University, Bangkok.

After analysing trees in different age classes in different quality sites, a correlation was worked out between d.b.h. and volume of heartwood present.

3556 Wangtara Buitan. 1967. **Testing the using of increment borer for finding the diameter teak growth**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The increment borer results compare favourably with direct measurement of diameter for calculation of mean annual increment.

3557 Warta, A.J. 1926. **Teak production in British India, Siam and the Netherlands East Indies**. (Dutch; English). Tectona 19: 493-508.

The difference in exploitation and marketing of products in British India and Dutch East Indies is compared and problems are discussed.

3558 Warta, A.J. 1926. **The abnormal ratio of the presence of different lengths in the teak timber of forest service**. (Dutch; English). Tectona 19: 843-847.

The abnormal ratio of the presence of different lengths in a given size of teak timber is described and a method is indicated to periodically control this defect.

3559 Weaver, P.L; Francis, J.K. 1990. **The performance of *Tectona grandis* in Puerto Rico**. Commonwealth Forestry Review 69(4): 313-323.

Twenty-seven plantations of teak were surveyed in Puerto Rico. Nearly half of the plantations surveyed appeared to be attaining at least 24 m height in 50 years. The best growth was at relatively low altitude sites with deep well-drained soils. Growth is compared with teak plantations in the Caribbean.

3560 Weeraratna, W.G. 1957. **Some growth data of teak in Ceylon**. Ceylon Forester 3(2): 167-170.

The progress of crop diameter growth is investigated in sample plots, representing five of the more important teak growing centres in Ceylon, namely, Pullumaliai, Vakaneri, Palugama, Madawachchiya and Mihintale.

3561 Weerawaradne, N.D.R. 2000. **Site, technology and productivity of teak plantations in Sri Lanka**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 69-82. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

Teak is one of the most demanding and valuable timber species grown in Sri Lanka. The Forest Department is mainly responsible for plantation establishment since the 1870s. Under a five year program state lands is leased to private individuals for a period of thirty years and technical support is provided for planting teak. Discussed the silvicultural management practices and the financial analysis of plantations in the country.

3562 Wehlburg, A.F. 1909. **More on young growth on so called contract cultivation**. Tectona 1: p562; 2: p22.

3563 Wilhemi, T. 1950. **The increment of teak according to Indian and Netherlands-Indian yield tables**. Mitt. Bundesanst. Forst u. Holzw. 20: 11p.

Data for the top quality classes in India and Java show only slight differences. Increment in volume and dry wood substance is compared, using Weck's absolute height quality with that of European species.

3564 Wimbush, A. 1920. **Big teak in Madras**. Indian Forester 46(5): 247-249.

Records a tree recently felled at Palacadavu in South Coimbatore which yielded 5 logs with an outturn of 1099 cu.ft., and also yield of 100 other big teak which yielded 210 logs of 28922 cu.ft. with an average volume of 138 cu.ft. per log.

3565 Win, S; Kumazaki, M. 1998. **Teak yield regulation in the natural forests of the Tharrawaddy Forest Division, Myanmar: 138 years of the girth limit selection system**. Journal of Forest Planning 4(2): 43-51.

Attempts to introduce scientific management techniques to forestry in Myanmar began in 1856 with the appointment of D. Brandis. Main management objective was to ensure a permanent and sustained yield of teak from the natural forests. To this end a girth limit selection system was adopted in the Tharrawaddy forests of Pegu, with the minimum exploitable girth limit set at 6 feet.

3566 Wiroatmodjo, R.S; Effendi, R.M. 1957. **The correlation between density of the canopy and density according to basal area in teak stands**. (Javanese). Rimba Indonesia 6(1/2): 35-51.

Measurements were made on sample plots in teak plantations of different site quality and age. Results indicate that in young and old stands where density of the canopy is low and in young stands where it is high.

3567 Wiroatmodjo, R.S; Effendi, R.M. 1958. **Increased felling yield and the estimation of volume in teak forests**. (Javanese). Rimba Indonesia 7(10/12): 462-475.

The increased demand for teak in Indonesia in recent years, and the consequent reduction in quality requirements, have led to the felling of a greater volume of timber. Crop volume of mature teak plantations has been calculated as timber volume but in present conditions it can best be calculated as stemwood volume, i.e. as containing some lower-quality material.

3568 Wolff von Wulfing, H.E. 1926. **Yield tables and estimates**. Tectona 19: 1017-1039.

Discusses the need for new yield tables and local yield tables for teak and suggests a method for preparation of stem volume table in estimating workable timber on the principle of largest possible output under the existing classification for sizes and quality.

3569 Wolff von Wulfing, H.E. 1929. **The appearance of longitudinal furrows in *Tectona grandis* Linn.f**. Tectona 22: 723-779.

3570 Wolff von Wulfing, H.E. 1929. **The occurrence of furrows and fluting at breast height in plantation-grown teak (*Tectona grandis* Linn.f.)**. Korte Meded-Lingeen Proefstation Boschbow, Buitenzorg 16: 57p.

3571 Wolff von Wulfing, H.E. 1931. **A comparison of the teak plantation with stands of European timbers**. Tectona 24: 825-865; p1091.

Various characteristics of stands including number of trees left and removed, volume production, basal area, heights, diameter etc. are compared. At these ages basal area and heights are maximum for teak.

3572 Wolff von Wulfing, H.E. 1932. **Yield tables for teak plantations (*Tectona grandis* Linn.f.)**. Tectona 25(11): 1425-1509; Indonesian Forest Research Institute Publication No. 30a.

This paper discusses the teak sample plot investigations in Java started in 1895. They were undertaken to obtain an idea of the annual increment of teak plantations under varying forms and intensities of thinning.

3573 Wolff von Wulfing, H.E. 1932. **The sample plot investigation of A.E.J. Bruinsamma yield tables for teak plantations (Tectona grandis Linn.f.)**. Tectona 25(11): 1425-1509; Korte Meded. Proefsta Boschbouw 30a: 85p.

Paper discusses Bruinsma's sample plot investigation of Java teak aiming at determining annual increment of teak plantations under varying forms and intensities of thinnings, regeneration experiments by coppice and seed shoots. It is considered uneconomical to resort to natural regeneration on good soils and artificial regeneration is cheaper and quicker. The method of preparation of yield tables is explained.

3574 Wolff von Wulfing, H.E. 1933. **General volume and stem table together with some auxiliary tables for plantation grown teak (*Tectona grandis* Linn.f.)**. Bijlage Meded. Boschbouw Proefsta 27: p329.

Method of preparation of general volume tables for teak was described and results are compared statistically and correlations and interpretations for form quotients and form factors adopted was also given.

3575 Wolff von Wulfing, H.E. 1934. **Volume tables for the stands of teak plantations**. Tectona 27; Indian Forest Bulletin 87.

3576 Wolff von Wulfing, H.E. 1938. **Yield tables for even-aged plantations of Java teak - *Tectona grandis***. (Dutch). Tectona 31(3): 562-579; Korte Meded. Boschbouw. Proefsta. 63.

Yield tables for 6 quality classes for years 5 to 110 for thinnings and main crop and total production are given.

3577 Wutisatrian, A. 1967. **Stem analysis of teak in Mae Huad teak plantation, Lampang**. (Thai). Student Thesis. Kasetsart University, Bangkok.

At the age of 3 years height 3.20 m/and basal area at b.h. is 8 cm2 with a volume of 0.003 m2. At the age of 24 years the basal area increase 204 cm2 and volume 0.1625 m3.

3578 Yadav, A.S; Khare, P.K; Mishra, G.P. 1986. **Growth analysis and dry matter production of seedlings of tropical dry deciduous forest tree species of central India. 1. Teak - *Tectona grandis* Linn.f.** Journal of Tropical Forestry 2(4): 228-234.

Relative growth rate, net assimilation rate and average leaf area to weight ratio were calculated.

3579 Yawuthi, Ch. 1968. **Correlation between the growth in diameter of teak (*Tectona grandis* Linn.f.) and the depth of A-horizon of Thachai teak plantation, 1954, Sukhothai Province**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Diameter growth is significantly correlated to A-horizon depth. Stump diameter is also similarly correlated.

3580 Zambrano, T; Jerez, M; Vincent, L. 1995. **Preliminary simulation model of basal area growth of teak (*Tectona grandis*) on the Venezuelan western plains**. (Spanish). Revista Forestal Venezolana 29(39/41): 40-48.

Dynamic growth information was obtained from plots established in teak plantations in the Caparo Forest Reserve which represented different planting densities. Graphs are presented which enabled the permitted teak development in Ticoporo to be compared with that of Caparo and the prediction of yields.

3581 Zambrano, T; Suarez, M; Jerez, M. 2001. **An evaluation of precision of some regression models for estimating height-diameter rela-**

tionship in Teak (*Tectona grandis* Linn.f.) from thinned permanent plots. (Spanish). Revista Forestal Venezolana 45(2): 163-173.

Eleven linear and nonlinear regression models were tested for estimating height-diameter relationships in teak plantations using data obtained from plots at the Caparo Forest Reserve Experimental Station in Barinas, Venezuela. Height-diameter relationships are used in growth and yield models to predict the mean height for a given diameter at breast height or diameter class.

3582 Zech, W; Drechsel, P. 1991. **Relationships between growth, mineral nutrition and site factors of teak (*Tectona grandis*) plantations in the rain forest zone of Liberia**. Forest Ecology and Management 41(3/4): 221-235.

In 5- to 11-year-old teak plantations at Glaro, Cavalla and Bomi Hills in Liberia, growth and vigour of trees showed considerable variations. Deficiency symptoms as well as soil and plant analyses indicated that differences in growth intensity were mainly related to topsoil acidity and foliar calcium status.

3583 Zondag, J.L.P. 1927. **The proportions in length of the output of teak timber**. Tectona 20: 214-222.

The method of regulating cutting of teak to produce longer lengths followed in North Randieblatoeng has been described and cost influences of wages of labour on length of timber discussed.

3584 Zwart, W. 1938. **Classification of output from fellings in teak forest in Tjepoe (Java)**. (Dutch). Tectona 31(8): 549-554.

Go top

Productivity

3585 **The teak forests of Java**. Indian Forester 7(3), 1882: 212-214.

Steps taken for the conservation of teak forests of Java are reported. It is concluded that with a strict conservancy and extensive planting operations, Java will again rise into importance as one of the main sources of supply of teak timber for the European markets. The paper also contains detailed accounts on the history of teak forests of Java their extent and management.

3586 **Statistics of teak cultivation in Java**. (Dutch). Tectona 4, 1911: 340-348.

3587 **Suggestions for a new system of royalty payment for teak forests in Burma worked by lessees under purchase contract**. Indian Forester 42(1), 1916: 1-4.

Commenting on the present system of leasing out teak forests, the author suggests a new system to avoid delays, increase yields, reducing wastage, and working more efficiently and economically, and suggests royalty to be fixed per girdled tree.

3588 **Burma teak**. Indian Forester 62(7), 1936: p440.

A review of an illustrated and fascinating brochure issued by five large teak firms of Burma having leases with Government.

3589 **Annual report on the forest administration of Nigeria for the year 1940**. Government Printer, Lagos, 1941: 14p.

Teak has been raised successfully from direct sowings.

3590 **Administration report on the Forest Department in the Central Provinces & Berar for the year ending the 31st March, 1940**. Government Printing, Nagpur, 1941: 38p.

Bamboo regrowth may be a serious obstacle to teak coppice in the moist type. This can be overcome by felling and burning the bamboo a year or so before main fellings, cutting the regrowth with the tree crop, burning the felling debris, and removing all bamboos interfering with teak coppice.

3591 **Forest management research. Humid tuffaceous loams**. Caribbean Forester 16(1/2), 1955: 3-4 [15th Report of United States Tropical Forest Research Centre 1954].

Reports on the development of plantations on this type of site. A 16-year-old teak plantation in the Luquillo Forest on the exposed slope has attained a basal area of more than 100 sq. ft./acre, but the form of the trees is not as good as on deeper soils.

3592 **Annual report for 1962. Institute of Tropical forestry**. Caribbean Forester 24, 1963: 1-17.

Variations in the growth rate and form of *Tectona grandis* have been observed and it appeared that some of these were herditary.

3593 **Economic analysis of investments in forest plantations in Ecuador**. (Spanish). Direccion Nacional Forestal, Ministerio de Agricultura, Quito, Ecuador, 1987.

Out of six papers the following paper was on teak. Productive teak plantations in the tropical region of Ecuador.

3594 **Management and development of forest plantations using multipurpose species: Proceedings of a IUFRO meeting, Guatemala, April 1989**: 675p. Centro Agronomico Tropical de Investigacion y Ensenanza, Turrialba, Costa Rica, 1990.

Thirteen papers are on silviculture of various species including *Tectona grandis*.

3595 **Forestry and people in South-East Asia**. Bos Nieuwsletter 14(3), 1995: 112p. Foundation BOS, Organization for International Forestry Cooperation, Wageningen, Netherlands.

Out of a total of 11 papers one paper is on teak planting by farmers in Lao PDR .

3596 **Myanmar: Ample headroom in wood processing**. Asian Timber 15(3), 1996: 16-18.

Myanmar has three quarters of the world's premium teak supply. This article discusses resources of *Tectona grandis* and secondary timbers, the industry and opportunities for investment.

3597 Ainslie, J.R. 1930. **Teak sample plots in Nigeria**. Forest Administration Annual Report, Nigeria 1930: 18p.

3598 Aitchson, P.E. 1957. **Working plan for the Mandgod-teak pole forest in Kanara Eastern Division**. Forest Department, Mysore.

3599 Alfaro Murillo M de los, A. 1990. **Case study on the profitability and optimum use of resources in the forest plantations of Costa Rica**. (Spanish). 162p. Centro Agronomico Tropical de Investigacion y Ensenanza, Turrialba, Costa Rica.

The land used was classified into 3 site classes of I-III for which preliminary yield tables were developed for each species. Data on the costs of establishing and maintaining each class and species of plantation, and incomes and yields for each were collected and analysed using a linear programming model to give present net worth, internal rate of return and soil expectation value . The highest IRR was with *T. grandis*.

3600 Anstruther, K. 1897. **The scarcity of teak**. Indian Forester 23(1): 54-55.

The measures taken by the Forestry Service in Government of Burma and Siam to conserve teak are outlined and discussed.

3601 Ashutosh, S; Chand Basha, S; Pant, N.C; Sharma, R. 1994. **Considerations of demand-pattern and economic return of forest management and rationalisation of pricing of timber (teak)**. Indian Forester 120(6): 483-487.

For optimal returns from forest plantations, it is necessary to follow a management plan which is developed after consideration of the implications of demand pattern, rate of tree growth, and economic return in terms of sustainable utilization. It is suggested to have a rational basis for pricing of the final product. In this paper, a theoretical analysis is undertaken of these concepts using cost data from a hypothetical teak plantation and data on market demand from Jabalpur, Madhya Pradesh.

3602 Atkinson, D.J. 1937. **A note on the finances of the Kyetpyugan teak plantations**. Indian Forester 63(12): 814-826.

3603 Aung, K.M. 1983. **Management planning for teak forests in Burma. Ph D Thesis**. Forestry Abstracts 44(10): p599.

Abstract is provided.

3604 Aung, N.N. 1998. **Changes in the price structure of teak from 1936 to 1998**. Myanmar Timber Enterprise Commemorative Issue: 278p.

3605 Balagopalan, M; Nandakumar, U.N; Indira, E.P; Jayaraman, K; Varma, R.V; Mammen, C. 2001. **Problems and prospects of management of teak plantations in Kerala**. Tropical Forestry Research: Challenges in the New Millennium. Proceedings of the International Symposium, Peechi, India, 2-4 August 2000. R.V. Varma; K.V. Bhat; E.M. Muralidharan; J.K. Sharma, Eds: 183-191. Kerala Forest Research Institute, Peechi.

Various issues related to silviculture, genetic improvement, soil requirements, pest problems, productivity and economics of cultivation of teak in the context of past research results and current practices are discussed. Studies on nursery techniques and production of quality stock, plantation establishment, maintenance and harvesting practices are reviewed. The need for protecting the ecotypes and other gene pools is emphasized. The problems and causes for low fruit productivity in teak seed orchards are examined and the present status discussed.

3606 Ball, J.B; Pandey, D; Hirai, S. 2000. **Global overview of teak plantations**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 11-34. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

This paper examines trends in the establishment of teak plantations worldwide and identifies some of the environmental and economic issues and challenges for investors. An historical review of teak plantations of India, Myanmar, Lao PDR Thailand, Sri Lanka, Nigeria, Ghana, Cote d'Ivoire, Tropical Africa, Tropical America, etc. is provided. Teak plantation areas and the planting rates of teak plantations are also reported. Productivity and volume estimates of teak plantations are also discussed. Contributions of plantation programmes towards teak timber supplies are also examined. The cost of plantation establishment and maintenance and the financial returns from these plantations are also discussed. Recent trends in the establishment of teak plantations are also discussed.

3607 Balooni, K. 2000. **Teak investment programmes: An Indian perspective**. Unasylva 51(201): 22-28.

This article examines the growing importance of investment in tree plantations in India, the involvement of forest based industries in raising plantations to meet their raw material requirements and the myths and realities surrounding teak investment programmes.

3608 Banijbhatana, D. 1956. **Teak forests of Thailand**. Proceedings of the 4th World Forestry Congress, Dehra Dun, 1954: 299-311.

Describes the principal forest types, stocking of teak, reservation, and working plans.

3609 Banijbhatana, D. 1957. **Teak forests in Thailand**. Tropical Silviculture 2. FAO Forest and Forest Product Studies 13: 193-205.

Describes distribution and extent of teak forests, factors governing the same-climate, topography, geology and soil. Gives teak forest types, growth statistics, reservation and working plans in Thailand. The rate of growth of teak varies with site quality.

3610 Banjibhatana, D. 1962. **The management of forests in Thailand**. Royal Forest Department, Bangkok 49: 1-12.

3611 Barbour, R; Gonzales, De M.M. 1958. **Forestry survey report to the Government of Eucador**. FAO/EPTA Report 748. FAO, Rome.

Report on forestry of Eucador gives details under forest types, forest improvement, transportation, forest industries, forest utilization, land use, reforestation, forestry nursery, forestry research, forest policy and appendices on tree species - teak plantation cost, forest products, export and import.

3612 Beck, H.J.L. 1932. **The definite organization for teak forestry**. (Indonesian; English). Tectona 25: 1410-1424.

3613 Beddome, R.H. 1878. **Report upon the Nilambur teak plantations**. Government of Madras.

3614 Beekman, H. 1914. **Working plan for research into the most efficient management and yield of teak stands**. (Indonesian; English). Tectona 7: 219-244.

3615 Beekman, H. 1918. **Working plan for the thinnings and output research and research into the flora of the teak forest**. (Indonesian; English). Korte Meded Proefsta Boschw: 1-35.

3616 Beekman, H. 1920. **Economic results that come from an analysis of a teak stands**. (Indonesian; English). Tectona 13: 166p.

3617 Beekman, H. 1920. **Teak in Java**. CFI, Oxford.

3618 Beekman, H. 1920. **The financial cycle of the full grown teak forests in clear felling operations with respect to IV. 'Groeiplaatsboniteit' (site quality class) in the forest district of Margasari, Java**. (Indonesian; English). Meded Proefsta Boschw 6: 166p.

Discusses the financial rotation for high-stemmed teak forest under clear fellings system on fourth site class in the forest district Margasari, Java.

3619 Begue, L. 1956. **The first session of the Teak sub-commission of FAO, Bangkok**. Bois et Forests des Tropiques 48: 7-19.

Gives some figures for production and a general description of teak in Thailand, as well as an account of the conference.

3620 Bekker, C; Rance, W; Monteuuis, O. 2004. **Teak in Tanzania: II. The Kilombero Valley Teak Company**. Bois et Forests des Tropiques 279: 11-21.

The Kilombero Valley Teak Company was set up in 1992 in Tanzania by the Commonwealth Development Company to supply the world market with Tanzanian plantation teak. This paper reports the main characteristics and accomplishments of the Kilombero Valley Teak Company project and orientations for the future.

3621 Bellouard, P. 1954. **Teak in French East Africa**. (French). Centre Technique Forestier Tropical, Nogent-sur-Marane (F.).

3622 Berkhout, A.H. 1899. **The future of teak forests in danger**. Indian Guide.

3623 Bertha, R.A; Vicente, S.M; Bello, A; Hector, C. 1996. **Initial growth and economical and ecological importance of 10 forest tropical species**. Proceedings of Scientific and Technological Meeting of Forestry, Agriculture and Husbandry, Mexico, 1996: 7p.

Including teak.

3624 Best, J.W. 1920. **Teak plantations in the Melghat Division of Berar**. Indian Forester 46(8): 411-415.

In the Sipna valley of Berar, earliest teak planting was taken up in 1868 and by 1879 a plantation of about 1000 acres were raised and commenting on their present condition and growth rates the author considers teak growing as a sound financial endeavour.

3625 Best, J.W. 1920. **Treatment of teak forest in the Central Provinces**. Indian Forester 46(4): 199-200.

3626 Beversluis, J.R. 1926. **Production costs of teak timber**. (Indonesian; English). Tectona 19: 1063-1069.

The paper is considered as an analysis of certain results of the working of teak forests in Java under definite working plans, but is not meant to calculate and lay down principles of remunerativeness of teak forests and give indications on the financial concepts and business like actions of the forestry service.

3627 Bhat, K.M. 1997. **Managing teak plantations for super quality timber**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 28-31. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

This paper examines the scope for production of super quality timber in future teak plantations. The available data indicate tremendous opportunities for wood technologists to exercise control over the wood properties not only to minimise timber defects of proportion of knots, juvenile wood, tension wood, etc. but also to improve the inherent qualities, when trees are to prepare an action plan and conduct research for evolving suitable management strategies to maximise the yield of superior-quality timber in future plantations.

3628 Block, F. 1922. **The teak forest district of Java during the last years**. (Indonesian; English). Tectona 15: 523-540.

Measures recommended include establishment of centralised accounting service, increasing the output proportionate with demand and allowable maximum and by better exploitation and felling methods, formation of timber stock, fixation of maximum price according to market conditions and production costs, lowering production costs by smaller wages, less personnal, avoiding capital investment, better forest production and simple working activities and change of timber sales policy after consulting the timber trade interests.

3629 Boer R.C de; Kuiper, L.C. 1996. **Teak, beautiful gold brown heart wood**. (Dutch). Bos en Hout Berichten, Stichting Bos en Hout 12: 4p. Stichting Bos en Hout, Wageningen.

Environment friendly investments in teak plantations in Netherlands are discussed. The origins of teak, growth assessments, timber quality, marketing are described.

3630 Bothmer K.H von. 1990. **The prospects for the teak economy in West Africa**. (German). Internationales Afrika Forum 26(2): 181-188.

An assessment is made of experience with teak in Togo and Benin. Details are given of the physical and socio-economic conditions in the region and the silviculture and performance of teak.

3631 Brandis, D. 1856. **Teak forests of Pegu**. Government Publication, Burma Forest Department.

3632 Brandis, D. 1861. **Attaran forests (Burma)**.

Government Publication, Burma Forest Department.

3633 Brandis, D. 1898. **Forest organization in teak plantations of Pegu, Burma**. Allg. Forest-u. Jagdztg 74: p45.

3634 Brascamp, E.H.B. 1915. **The civilisation of people in residency Rembang and management of teak forests**. Tectona 8: p72.

3635 Brascamp, E.H.B. 1921. **Report from teak forests from Sidajoe about 1706**. Tectona 14(8): 811-813.

3636 Brascamp, E.H.B. 1921. **The teak forests of Pemalang, Tegal and Brebes in the year 1803, in Kolonial Archief No. XXIX**. Tectona 14(2): 925-928.

3637 Brascamp, E.H.B. 1922. **New Guinea, teak forests and no Hindoos**. (Indonesian; English). Tectona 15: 251-262.

Madjapahit Javanese may not have planted teak in New Guinea. The author is of the opinion that teak was not brought there by Hindoos or Europeans.

3638 Brennan, P. 1993. **SEC accuses local teak firm**. The Tico Times 37(1215). San Jose, Costa Rica.

3639 Browne, R.S. 1929. **Report on a tour of inspection of some of the teak plantations in the State of Travancore**. Indian Forester 55(11): 627-638.

Discussed methods of regeneration employed, seed collection and nursery techniques, planting, tending of teak and field crops and weeding and harvesting of main teak and agricultural crops. A note on merits of taungya and regular plantations is given with a description of climate, soil and locality factors of plantation areas in various forest divisions. The problem of growing pure teak plantations and suitable mixtures is also discussed and compared with Nilambur.

3640 Bruinsma, A.E.J. 1894. **Forestry in the Dutch East Indies**. East Indies Guide.

3641 Buffe, J. 1961. **Teak plantations in Dahomey**. (French). Centre Technique Forestier Tropical, Nogent-sur-Marne: 18p.

Nursery practice, plantation methods, increment and yield and financial returns are described and the economic, social and political results of the plantations are discussed.

3642 Centeno, J.C. 1997. **Yield expectations of teak plantations. Trade in illusions**. (Dutch). Nederlands Bosbouwtijdschrift 69(1): 2-8.

The history and background of private investments by Dutch people in teak plantations in Costa Rica are discussed. Problems with conflicting data on increments are outlined.

3643 Cermac, F. 1954. **Report to the Government of Indonesia**. FAO/EPTA Report 309.

Describes the present timber production from teak forests and the need for a mechanization of logging. Notes are also given on the influence of mechanical extraction on natural regeneration of teak.

3644 Chalmers, W.S; Kenny, J.S; Bacon, P.R. 1981. **The natural resources of Trinidad and Tobago**. 223p. Edward Arnold (Publishers), London.

The physical, biological and human resources of Trinidad and Tobago are described. Included chapters on local sources of timber, utilization of forest products, plantation forestry including teak plantations, forest management and research, recreation, wildlife, national parks and indirect benefits of forestry.

3645 Champion, H.G. 1928. **Teak forests of Central and South India**. British Empire Forestry Conference Papers: 454p.

3646 Chatterjee, N. 1978. **Single factor analysis - a decision criterion for forestry operations**. Indian Forester 104(7): 506-516. 6.

This analysis can be used to decide what, if any, funds should be allotted for various forestry operations, by calculating their cost-effectiveness. The method is illustrated by applying it to a weeding and cleaning regime for a typical (hypothetical) teak plantation.

3647 Chatterji, A.L. 1882. **The korai teak forest**. Indian Forester 8: 266-268.

The Ghat forests of Satpura mountains largely teak type are described, its past management and results of fire protection are discussed. Experiments on coppicing of teak, yield and revenue from coppice fellings is given.

3648 Chaturvedi, A.N. 1995. **The viability of commercial teak plantation projects**. Indian Forester 121(6): 550-552.

Silvicultural aspects of the viability of commercial teak plantations in India are discussed.

3649 Chotipatana, P. 1966. **Teak forest management in Thailand**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The paper discusses the teak forest management in Thailand.

3650 Chowdhury, A.M. 1951. **Future of teak plantations**. Pakistan Journal of Forestry 1(4): 403-404.

3651 Contreras, G. 1992. **Economic assessment of forestry project impacts**. FAO Forestry Paper 17: 193p. FAO.

3652 Degbey, E.K. 1991. **Estimation of the valorisation costs of thinning products and thresholds of rentability of a forest project. The case of UGETAP project**. Ecole Superieure d' Agronomie, Togo: 183p.

3653 Doorn, A van. 1919. **About the teak forests of Damascsche in 1772 by E.H.B. Brascamp**. Tectona 12: 773-774.

3654 Doorn, Z van. 1926. **Costs of production in teak plantations**. (Indonesian; English). Tectona 19: 891-903.

Analyses cost of production in teak plantation.

3655 Doorn, Z van. 1927. **Is the organization of a Government teak business in the next business law etc. necessary or desirable?** Tectona 20: 612-619.

3656 Draaisma, C.L.M. 1928. **The development of the management of teak forests in Java**. Het Djati Bosch Bedrijf op Java: 127-172. Archiepel-Drukkeit, Buitenzorg.

3657 Draaisma, C.L.M. 1972. **The development of the management of the teak forests in Java**. Tectona 20: 153-198.

The different systems of teak forest management and their history since 1890 and forest regulations were traced and the author proposes reorganisation of staffing pattern of forest department to meet the present day needs and decentralization of work and executive powers.

3658 Duyfjes, J.J. 1923. **A bird's eye view of the management of the forests in Java in the years 1911-1920**. (Dutch; English). Tectona 16: 1-6.

An examination of the output of teak forests and the financial results of the system of forest management which clearly shows the stability of the policy under which these forests have been managed in the decade 1911-1920.

3659 Enters, T. 2000. **Site, technology and productivity of teak plantations in Southeast Asia**. Unasylva 51(201): 55-61.

Recommendations are given of the seminar organized by TEAKNET and FAO's Forestry Research Support Programme for Asia and the Pacific (FORSPA) in Thailand in 1999.

3660 Evers, J. 1905. **The Muthodi teak plantation of 1903-1904**. Indian Forester 31(12): 688-694.

The Muthodi state forest is described and teak planting since 1903 is discussed. Cost of silviculture management up to third year is also given.

3661 Fanani, Z; Kobashi, S; Miwa, K. 1990. **Development of the database for teak forest management in Java, Indonesia**. Bulletin of the Kyoto University Forests 62: 168-184.

The use of a computer database of forest inventory, soil type, land use, and topography to aid forest management is illustrated using as an example of the Mantingan Forest District, central Java.

3662 FAO. 1956. **National progress report on teak forestry: Burma**. FAO Teak Sub-Commission, Bangkok FAO/TSC-56/22: 13p.

3663 FAO. 1956. **National progress report on teak: India**. FAO Teak Sub-Commission, Bangkok FAO/TSC-56/27: 28p.

3664 FAO. 1956. **Report of the first session of teak sub-commission, Bangkok, Thailand, 9-18 February 1956**. FAO Teak Sub-Commission Bangkok FAO/TSC-56/30: 39p.

Includes recommendations of the first session, and national progress reports, presented to the first session of TSC at Bangkok, in Thailand, by Burma, France, India, Indonesia, Japan, Laos and Thailand.

3665 FAO. 1956. **Report on teak in Laos**. FAO Teak Sub-Commission, Bangkok FAO/TSC-56/9: 5p.

3666 FAO. 1957. **Report of the second session of the teak sub-commission at Bandung, Indonesia, 4-10 June 1957**. FAO, Rome FAO/TSC-57/31: 34p.

Report includes in addition lists of documents of the session and report, secretariat report and notes on the silviculture and management of teak, utilization, teak production, trade and prices, teak grading rules etc.

3667 FAO. 1960. **Progress report on teak forestry in Burma**. FAO Teak Sub-Commission, New Delhi FAO/TSC-60/2/3: 2p.

A brief report to the Teak Sub-Commission on teak forestry in Burma, on silviculture, management, utilization, production and grading rules.

3668 FAO. 1984. **Intensive multiple-use forest management in Kerala**. FAO Forestry Paper 53: 137p.

A case study reviewing existing management systems as applied to rain forests and teak plantations in the state. Forests cover about 25 percent of the land area and 16 percent of the forest area has plantations in Kerala. Plantation forestry dates back to the 1840s and systematic management of natural forest has been attempted in recent decades.

3669 FAO. 1995. **Forest resources assessment 1990: Tropical forest plantation resources**. FAO Forestry Paper 128. D. Pandey, Ed. FAO, Rome.

3670 Fock, W.H. 1910. **Position of Tectona (teak) forests in Soerakarta, Java**. (Dutch; English). Tectona 3: 237-262.

3671 Forest Department, Assam. 1939. **Notes from annual report on teak**. Annual Administration Report, Forest Department, Assam and Madras 1937/38.

Spacement and early stump planting trials in teak plantations are described. Irrigation is found to increase growth rate of teak. Methods of raising and mixtures suited for various soils are discussed.

3672 Forest Department, Madras. 1918. **Statistics of Nilambur teak plantations**.

3673 Forest Service, Bogor. 1957. **The teak forests of Tjepu (Java): History of management and its working plans**. Forest Service, Bogor: 40p.

This brochure is meant to give a picture of the historic development and the management activities of the teak forests in the forest district Tjepu - as a model for intensive forest management plan.

3674 Gallant, M.N. 1938. **A new basis for royalty assessment on teak in Burma**. Empire Forestry Journal 17: 80-83.

The new basis for royalty assessment on teak in Burma is related to market conditions.

3675 Galloway, G. 1994. **Management of forest plantations. Technical guide for forestry extension**. Serie Tecnica: Manual Tecnico Centro Agronomico Tropical de Investigacion y Ensenanza 7: 59p, Coleccion Materiales de Extension 1. Turrialba, Costa Rica.

The species discussed in this guide which include *Tectona grandis*.

3676 Ganglo, J.C; Lejoly, J. 1999. **Teak in Benin: Management and prospects**. (French). Bois et Forests des Tropiques 261: 17-27.

Teak has been planted in the country for more than 50 years and is of considerable socioeconomic importance because it offers employment opportunities and exports provide foreign currency. Priority research goals are discussed which include the identification of indicator plants and vegetation communities which identify good teak production sites.

3677 Gangopadhyay, P.B. 1997. **Report of the inter-departmental committee on the growth and economics of private plantations of teak**. Ministry of Environment and Forests. Government of India.

3678 Garland, E.A. 1934. **Methods of management in the mixed deciduous teak-bearing forests of Kanara, Bombay presidency**. Indian Forester 60(12): 819-837.

The history and methods of past management were described and suggestions are made for future management and silvicultural treatment of these forests, and the various operations to be carried out to improve the yield is discussed.

3679 George, M.P. 1961. **Teak plantations of Kerala**. Indian Forester 87(11): 646-655.

History, management, increment, injuries, and financial aspects are described, and a short account is given of current research projects.

3680 Gogate, M.G; Joshi, V.S. 1996. **An approach to resolve controversy on economy of teak plantation projected by private companies, Maharashtra - a case study**. Indian Forester 122(12): 1092-1108.

Discusses the economic basis for projecting physical and financial returns from teak plantations in India, including yield tables, local volume tables, stand density, site quality, yield variations, expected timber and smallwood, timber specifications and prices and changes in these over the years. Presents a case study from Maharashtra, which addresses the aspects covered and illustrated by data on yields and prices. Returns are assessed over various rotations of rainfed and high-input plantations.

3681 Goswami, K.V; Singh, S.B. 1976. **Cost benefit analysis of afforestation in deep ravines of Gujarat**. Indian Journal of Agricultural Economics 31(1): 48-55.

Evaluates investment in afforestation of deep ravines with species including teak as additional sources of income for farmers.

3682 Gupta, H.S. 1996. **Tree plantation schemes: Whether feasible?** Van Vigyan 34(4): 176-181.

A detailed evaluation is made of commercial plantation scheme guaranteeing high quality and returns from teak plantations after 20 yr. Despite the uncertainties expressed over such schemes and the need for some form of governmental control of them is stressed.

3683 Haidery, A; Sinha, J.N. 1954. **Teak plantation in Saranda Division, Bihar**. Indian Forester 80(2): p118.

Gives an account of teak plantation in the damp valleys which originally contained quality I/II sal forest. The yield from thinnings and revenue obtained is given.

3684 Hambananda, P. 1956. **Teak plantations in Thailand. FAO country reports on teak**. Udom Press, Bangkok.

About 1000 hectares could be planted with teak annually. An agri silvicultural method of establishing plantations is adopted in order to reduce the cost of production.

3685 Hamzah, Z. 1978. **Survey report on teak plantations in Lampung and S. Sumatra Provinces (Indonesian)**. (Indonesian). Laporan, Lembaga Penelitian Hasil Hutan, Indonesia 276: 36p.

3686 Haque, M.S. 2003. **Current status, future prospects, economics and policy issues for teak (*Tectona grandis*) investments by NABARD**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

National Bank for Agriculture and Rural Development (NABARD) is a developmental bank provides credit for promotion of sustainable agriculture including forestry for integrated rural development. Teak has great promise in rehabilitation of India's degraded forests and for raising farm forestry on wastelands on sustainable basis. Many state owned forest development corporations (FDCs) have already raised excellent plantations after availing credit from NABARD/Banks on long term basis. Now FDCs are proposing short rotation, intensive, irrigated teak plantations. During the last decade many private entrepreneurs floated companies asking investments in teak equity with promise of high returns. Suggested that teak is really a good tree for investment and strongly recommend for raising commercial plantations by the farmers and the FDCs on wastelands.

3687 Hardcastle, P. 1999. **Plantations: Potential and limitations**. World Bank Forest Policy Implementation Review and Strategy Development. Stakeholder Draft Document.

3688 Hardjosoediro, S. 1977. **The basic principles of planting and evaluation of teak forest management**. Gadjah Mada University, Yogyakarta, Indonesia.

3689 Harlow, C.M. 1919. **Treatment of teak forests in Central Provinces**. Indian Forester 45(10): 525-530.

The history of reservation and management of teak forests of Central Provinces is described. The note recommends a high forest system, instead of a coppice with standards or improvement felling system after discussing the present condition of crop and silvicultural prescriptions followed.

3690 Harnsongkhram, A. 1968. **Obstacle and opinion about teak plantations in N.E. Thailand**. (Thai). Proceedings of the first Sil-

vicultural Seminar, Royal Forest Department, Ministry of Agriculture R 118: 228-234.

The main obstacle is costs, labour and machinery. The planting stock has to be raised in advance to plant more areas and the planting procedures and time of planting has to be improved. For timely planting to utilise maximum growing season, the authorities should cooperate with local people.

3691 Hashim, M.N; Mohd Noor Mahat; Krishnapillay, B. 2002. ***Tectona grandis***. A manual for forest plantation establishment in Malaysia: 245-258. Forest Research Institute Malaysia, Kuala Lumpur, Malaysia.

3692 Hill, H.C. 1890. **Suggestions for administration, Coorg. History of teak plantations**. Government Publication, Central Provinces: 39p.

3693 Hissink, L.A.G. 1909. **Annual reports of the forestry service in the Netherlands East Indies teak forests in Java and their management**. Forest Department, East Indies.

3694 Hissink, L.A.G. 1909. **Teak forests of Java and their management**. Tectona 2: 628-633.

3695 Hodgson, C.M. 1898. **Teak plantations**. Indian Forester 24(4): 123-125.

The teak plantations in the Ataran valley in Tenassarium, Burma, are reported, the method of raising and problems of locality factors are discussed.

3696 Hodgson, C.M. 1904. **On certain important forest questions**. Indian Forester 30(10): 467-470; 31: p82.

Examines the factors contributing to reproduction of teak: Exposure of seed to heat, presence of suitable mineral matter in soil and overhead light. The main problems of germination of teak seed in natural forest are examined.

3697 Hopwood, S.F. 1916. **Teak wood**. Indian Forester 42(1): 18-22.

Commented on the increased and extensive use of teak wood, discusses the working plan prescriptions and yields of present working and measures to meet the increased demand.

3698 Ibbotson, B.R. 1966. **The cost of establishment of teak in Gambari forest reserve**. Bulletin of Nigerian Forest Department 26: 19-27.

3699 Indira Devi, P; Saju Varghese; Manoj Kumar; Pratheesh, V.S. 2003. **Economics of teak plantations in Kerala**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

The study on economics of teak plantations in Kerala was undertaken to evaluate the present business economics of teak plantations in Kerala under government ownership. The total cost of a hectare of plantation spread over the rotation period was estimated to Rs.159,385 of which 3.83 per cent was invested during the establishment period. The study revealed that the returns from the first thinnings was enough to realize the cost incurred till then. When taungya system was practiced in the state, the revenue exceeded the cost in the first year itself. It is suggested that the concentration should be on timely scientific management to ensure maximum yield as the average yields in many plantations are below the site potential.

3700 Jacob, M.P. 1933. **Report and working schemes for the Travancore teak plantations**. Forest Department, Madras. Government Printing & Stationary, Madras.

3701 Janssen, H.W. 1997. **Collaboration between forestry, nature, environment and trade is not necessarily an illusion. Teak wood and Julio Cesar Centeno. A reaction to Julio Centeno**. (Dutch). Nederlands Bosbouwtijdschrift 69(1): 9-15.

It outlines OHRA's view to the discussion on private investments in teak plantations in Costa Rica.

3702 Jawtha. 1934. **Collection of royalty on teak timber in Burma**. Indian Forester 60(5): 330-334.

The method of collection of royalty in Burma is explained and the problems of assessment and measurement of timber and the quality are critically examined and discussed in detail.

3703 Jayadev, T. 1947. **Nilambur teak plantations 1846-1946**. Indian Forester 73: 498-500.

In memorandum of the century old Nilambur teak plantations, traces out their history and describes the pioneering efforts

of Mr. Conolly and Mr. Chattu Menon. The total area under teak is 7700 acres and the target of planting is 60-70 acres for replanting of pure teak and 150 acres in mixed forests after clearfelling.

3704 Jayaraman, K; Sreekumar, V; Sunanda, C. 1994. **A glimpse at the status of teak plantations in Kerala**. Evergreen 32/33: 2-4.

An examination of the overall status of teak plantations in Kerala is made. Information of age structure, stocking and productivity levels of teak plantations in Kerala is given.

3705 Jayaraman, K; Zeide, B. 2003. **Optimal management of teak plantations**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

An efficient way to increase productivity of teak plantations is to optimize their density and rotation age. It is found that bringing up the density of understocked stands and reducing the index of overstocked stands will increase productivity by 42 percent. Bringing down the rotation age from the current 60 to 50 years will increase the returns by 2.6 percent.

3706 Jenstch. 1908. **Notes on teak in Java, Siam and East Africa**. Zeitschrift fur Forst. U-Jagdwesen 40: p807.

3707 Jha, M. 1999. **A preliminary study on comparative growth and economic returns from rainfed and irrigated teak plantations**. Indian Forester 125(12): 1198-1203.

A comparative study was made of the performance of a conventional rainfed teak plantation of the Maharashtra Forest Department and an irrigated private teak plantation on an adjacent site. Data collected on girth and height growth showed that irrigation in the early phase had positive effects on growth. The net profit in the irrigated plantation was 2.28 times more than that in the non-irrigated plantation. It is suggested that teak can be used profitably as a farm forestry species.

3708 Jnnes, C.A. 1908. **Madras District Gazattiers: Malabar Vol. 1**. Government Press, Madras: 71p. P.B. Evans, Ed.

3709 Joo, R.W; Lee, S.Y. 1996. **Investment environment for overseas tropical hardwood plantation forestry**. FRI Journal of Forest Science Seoul 53: 65-77.

From the perspective of securing hardwood log supplies from overseas for the Korea Republic, the suitability of several countries - Malaysia, Papua New Guinea and the Solomon Islands - for tropical hardwood plantation projects was examined. Information was collected and analysed on foreign investment opportunities for plantation forestry. The analysis showed that investment in fast-growing plantation projects is highly profitable for pulpwood production.

3710 Joshi, N.J. 1975. **Use of computer for calculating the internal rate of return of teak plantations in Thana forests of Maharashtra State**. Indian Forester 101(3): 165-169.

Briefly discusses the advantages of calculating the internal rate of return by computer and explains, with an abbreviated flow diagram, the use of an internal halving programme for the calculation. The internal rates of return for teak plantations in Thana calculated by computer are compared with the interest rates as calculated in the working plan for the reserved forests of Thana.

3711 Kartasubrata, J. 1993. **Sustainable forest management in Indonesia, case study: Teak forest in Java**. Duta Rimba 19(159/160): 33-47.

Topics covered include teak forest management during the Dutch East Indies Company (VOC) and post-VOC periods, personnel involved, organization, planning, reforestation, regulation of harvesting and socioeconomic aspects, needs from the forests, use of the taungya system, and the social forestry programme initiated in 1984.

3712 Keogh, R.M. 1979. **Does teak have a future in tropical America? A survey of *Tectona grandis* in the Caribbean, Central America, Venezuela and Colombia**. Unasylva 31(126): 13-19.

Data are presented on areas of plantations, provenances, increment and yield, volume production and thinning practices in the region. A provisional site classification chart is presented.

3713 Keogh, R.M. 1987. **The care and management of teak (*Tectona grandis* Linn.f.) plantations**. 48p. Universidad Nacional, Heredia, Costa Rica.

A practical field guide for use in the Caribbean, Central America, Venezuela and Colombia. Management of teak in pure plantations and in taungya and in mixed with various crops is described. A teak bibliography is included with a keyword index.

3714 Keogh, R.M. 2000. **New horizons for teak plantations**. Proceedings of the 3rd Regional Workshop on Teak, Indonesia.

3715 Kerala Forest Department. 1977. **Teak in Kerala**. Kerala Forest Department, Trivandrum.

3716 Khaziah, A.K. 1992. **Investment incentives for forest plantation**. Proceedings of the National Seminar on Economics of Forest Plantation, Malaysia, 24-26 February 1992: 99-108.

3717 Kinhal, G.A. 1995. **Technical and financial evaluation of green equities**. Indian Forester 121(6): 566-572.

This paper concentrates on the upcoming corporate sector in plantation forestry by way of either company investment or investment from the public, looking in particular at plantations on owned land using funds raised from the market by way of shares/equities/debentures. An analysis of proposals presently being floated by various companies is done in terms of technical feasibility and financial viability, using data from the Kerala Forest Department on raising teak plantations.

3718 Kondas, S. 1995. **Teak - A paragon of excellence**. Malaysian Forester 38(4): 111-125.

3719 Kondas, S. 1998. **Teak farming in private sector: Information needs**. ITTO sponsored training Workshop on Tropical Forestry and Timber Trade Statistics. M.S. Swaminathan Research Foundation, Chennai.

3720 Kotwal, E.K. 1953. **Financial aspects of artificial teak plantations in the Kanara district of the Bombay State**. Indian Forester 79(11): 626-627.

Analyses costs of establishment and revenue from thinnings for two plantations.

3721 Krishna Murthy, A.V.R.G. 1997. **An investment of Rs. 1000 in teak grows to Rs. 50000 in twenty years! Is it a myth or reality?** Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 232-235. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

An advertisement in leading dailies under the title 'Rs.1000 grows to Rs.50,000 in 20 years on a single teak tree' has stirred the investors as well as foresters. Author suggests that the projected return of Rs.50,000 per tree is impossible in 20 years and thus the claim is a myth.

3722 Krishnabumrung, V. 1959. **On the out turn percentage in the conversion of teak logs**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Depending on sawmill conversion figures the out-turn percentage of teak is given. The use of various equipment is also discussed.

3723 Krishnapillay, B; Noor Mahat, M; Norini, H; Zuhaidi, A.Y; Ghani, A.R.A; Mahmud, A.W. 1998. **Viability of planting teak and sentang in Malaysia**. Planter 74(862): 19-34.

The potential of planting teak and *Azadirachta excelsa* in Malaysia on a plantation basis for commercial timber production is discussed. Properties of these species, their suitability for growth in Malaysia and the financial return on investment are considered.

3724 Kuchli, C. 1990. **Teak, tapioca and the forest villages in Thailand**. (German). Schweizerische Zeitschrift fur Forstwesen 141(6): 463-477.

An historical review, covering the teak policy in Thailand, the decline of the teak industry since the 1960s, and the change from a subsistence to a market economy, with increased cultivation of cassava for tapioca production, teak concessions and illegal fellings; afforestation and reforestation efforts in the teak areas and the establishment of the first forest village, the achievements of the forest village programme and the future prospects.

3725 Kumar, P.J.D. 1989. **The economics of teak plantation - 1. The economic viewpoint**. Myforest 25(4): 397-408.

An examination of the economics of the principle of sustained yield forestry management, which gives priority to raising successor crops, rather than to exploitation of existing resources.

3726 Kumar, P.J.D. 1990. **The economics of teak plantation - II: The financial analysis**. Myforest 26(1): 73-93.

A financial analysis of teak plantations in North Kanara district, Karnataka, is undertaken. The studies covers silvicultural requirements, growth and yield, yield tables and standing crop, costs, net benefit flows, the role of market prices, the economics of teak plantation, optimal rotations under sustained yield, optimal rotations.

3727 Kumar, P.J.D. 1990. **The economics of teak plantation - III: Rotation, conversion, and the financial criterion**. Myforest 26(2): 105-117.

The papers examine the economics of teak plantings as part of the regeneration programme of the Karnataka Forest Department. Aspects discussed include the planting decision and the supply function, sustained yield and the cost of postponing planting, sustained yield and the cost of delayed conversion, the impact of the economic criterion, sustained yield and the interests of stability and sustained yield, stability and the interests of the poor.

3728 Kyi, Maung. 1959. **A critical study of the modern methods of forest management and yield regulation, with special reference to their application to the teak forests of Burma**. Thesis, Imperial Forestry Institute, University of Oxford: 197p.

The successive stages in the development of European forestry are traced from 14th century leading to the present day concept of sustained yield management aiming at coordination of silviculture and economics. The silvicultural and socio-economic conditions that affect this principle are discussed. The role of management of forests to achieve the desired silviculture and economic results is stressed. The history of forest management in Burma is stressed with special reference to Burma selection system.

3729 Kyi, Maung. 1962. **Basic experience paper on teak in Burma**. UNCSAT Conference United Nations, Geneva E/CONF.39/C/25, 51, 6991, 505, 506, 243: 7.

Includes paper contributed under this item on experience of Burma.

3730 Lal, J.B. 1973. **Economics of teak plantations - Ignored factors**. Forestry Conference (Silvicultural Conference) 6-10 December 1973, 97. Forest Research Institute, Dehra Dun.

The economic return from natural mixed miscellaneous forests are compared with the returns from teak plantations. It has been shown that such factors as the returns from other forest products like Tendu leaves, myrobalams, etc. in natural forests, the loss in fertility on conversion to plantation, ecological benefits of natural forests and the likely changes in demand of teak wood, the conversion to plantations has no improvement on the natural miscellaneous forests.

3731 Lamb, A.F.A. 1955. **Trinidad's teak forests**. Journal of Agricultural Society, Trinidad and Tobago 55(E).

3732 Lamb, A.F.A. 1957. **Teak in Trinidad**. Tropical Silviculture Vol. 2: 179-186, Forestry and Forest Products Studies 13. FAO, Rome.

Silviculture of gregarious forest types especially teak in Trinidad and Tobago dealt with its geographic distribution, ecological factor, planting, forest injury, forest protection, volume and yield.

3733 Lamb, A.F.A. 1967. **Impressions of Nigerian forestry after an absence of 23 years**. Commonwealth Forestry Institute, Oxford.

3734 Letourneux, C. 1956. **Costing forestry operations**. 12th Congress of International Union of Forest Research Organizations, Oxford, 1956 IUFRO 56/31/5: 4p.

Analyses costs for different types of plantation like teak by the taungya system in Indochina, Ceylon and Siam.

3735 Levingston, R. 1969. **Report of tour of teak forests of Togo**. FAO Tour Report 24.6.69 to 5.7.69, Appendix 2, Report 1: 6.

Summarises information on teak stands visited by experts giving in tables the basal area, dominant height, number of trees/ha., mean annual increment and observations are made on nursery and plantations establishment practices.

3736 Loetsch, F. 1960. **Report to the Government of Indonesia on the application of mean tree tariffs for the further development of forest management of the plantation forests**. FAO Report 1281, 1960: 114p. Expanded Technical Assistance Program, FAO, Rome.

Emphasizes the suitability of the volume table in the forest inventory of even-aged plantation forests, especially for tropical fast-growing species. Its advantages are simplicity and a sound statistical basis. A tariff was constructed for teak plantations.

3737 Lowe, R.G. 1973. **Plots in managed plantation crops in the high forest zone of Nigeria**. Federal Department of Forest Research, Nigeria, Research Paper Forest Series 17: 20p.

Gives preliminary increment data from managed and untreated plots of species including *Tectona grandis*.

3738 Lowrie, A.E. 1897. **Kumri teak plantations**. Indian Forester 23(10): 370-374.

The method of raising Kumri teak plantations in Kuramba forest village, Coorg are described including raising nurseries.

3739 Lugt, C.S. 1926. **The costs in teak forests of Java**. Tectona 19: 602-613.

3740 Mahalaha, S.H; Tewari, D.N. 1975. **Intensive forest management planning in Bastar**. Indian Forester 101(6): 307-313.

Discusses the need to increase the utilization of forests in the region, mainly by improved management. It is intended to replace existing stands with a maximum stocking of species selected as being economically desirable and amenable to the intensive management. Among these, prime consideration is given to species which include *Tectona grandis* and a comparison is made of benefit/cost ratios, net present value, and internal rate of return on various rotations.

3741 Maheut, J; Dommergues, Y. 1961. **The teak plantations of Casamance**. Centre Technique Forestier Tropical, Nogent-sur-Marne: 14p.

Discussed plantation technique, yields, financial returns and usefulness to the local population.

3742 Maitland, V.K. 1925. **Volume tables for *Tectona grandis* (teak) and *Shorea robusta* (sal), for the Central provinces**. Indian Forest Records 2(7), Silviculture Series: 215-222.

3743 Maldonado, G; Louppe, D. 2000. **Challenges of teak in Cote d'Ivoire**. Unasylva 51(201): 36-44.

An analysis of the choices made in the Cote d'Ivoire with regard to the development of teak production, national forest policy, teak trade and marketing in a changing national and international context.

3744 Mammen, C. 1986. **Pattern of investments in forestry and its implications on sustained yield management in Kerala**. M.Phil Dissertation. Centre for Development Studies, Thiruvananthapuram.

3745 Mammen, C. 2000. **Teak plantations in Kerala: An economic review**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 239-261. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

In Kerala, teak occupies the largest area among the plantations raised by the Forest Department. Several private companies have come forward with attractive return for investments in teak plantations during early 1990's. Analyzed the productivity and profitability of teak plantations in government forests in Kerala in order to assess the assertions made by the private sector.

3746 Mathauda, G.S. 1956. **Multiple yield table for teak**. Indian Forest Records (n.s.) Silvicultural Series. Forest Research Institute, Dehra Dun.

3747 McGregor, A. 1877. **Memorandum on the Conolly teak plantations at Pelambur, Malabar district**. Indian Forester 3(2): 101-111.

3748 McIntosh, R. 1905. **The Nilambur teak plantations**. Indian Forester 31(3): 127-132.

The history of raising teak plantations in Malabar since 1840 due to pioneering efforts of Mr. Conolly and Mr. Chattu Menon, specially the problems encountered in teak seed germination and transplanting are discussed. The systems of management and tending of these plantations under different schemes is traced and forecast of yield and stocking given.

3749 McKerlie, J.E. 1958. **The prospects of teak in Tanganyika**. Imperial Forestry Institute, Oxford: 29p.

Analyses the environmental factors in teak growing countries, compared them with those of Tanganyika. Also reviews and analyses the requirements of teak against background conditions prevailing in Tanganyika.

3750 Mehendale, V.D. 1959. **Teak in Northern and Central Bombay**. Proceedings of All-India Teak Study Tour and Symposium December 1957-January 1958, Dehra Dun: 148-153.

Gives notes of occurrence, forest types, outlines of present methods of treatment under selection-cum-improvement cum clear-felling, coppice system, improvement

fellings, natural regeneration in dry deciduous and moist deciduous forests, artificial regeneration, tending and production.

3751 Mehta, U.V. 1995. **Technical and financial viability of commercial plantation: A study of teak plantation schemes in Gujarat and Tamil Nadu**. M.Phil Thesis. Indian Institute of Forest Management, Bhopal, India.

3752 Meka, E.Z; Adetchessi, L. 2002. **Forestry in development**. ITTO Tropical Forest Update 12(2): 3-5.

This paper describes an International Tropical Timber Organization project for a 2500-ha timber production plantation in the reserved forest of Haho-Baloe in Togo, for which financing agreement was signed in 1998. The project includes various forestry activities, such as logging and re-establishment of the teak plantations, the production of seedlings, the establishment of new plantations, and the protection, restoration and management of residual natural forests.

3753 Ministry of Trade and Industry, Malaysia. 1986. **Investment in the manufacturing sector - policies, incentives and procedures**. Ministry of Trade and Industry, Malaysia.

3754 Misra, D.N; Sathe, P.G; Mathur, R.S. 1975. **Return from standing timber in project-evaluation. Analysis of Maharashtra project**. Indian Forester 101(12): 723-729.

Criticizes some assumptions made in the assessment of the profitability of this project.

3755 Mitra, T.K. 1959. **The problem of teak plantation in the Kurseong Forest Division**. Proceedings of All-India Study Tour and Symposium for Teak December 1957-January 1958, Dehra Dun: 179-184.

History, distribution of areas for teak regeneration and management, locality factors, character of original vegetation, regeneration techniques, problems and remedial measures are discussed.

3756 Mizra, N.M; Mahendra, A.K; Ansari, M.Y. 1987. **Price trends of teak (round logs) in Orissa**. Indian Forester 113(5): 345-351.

Price data from the Forest Research Institute Timber Price Bulletins were analysed for 1968-81. The average annual growth rate of prices was highest for the larger girth classes. A comparison of trends in teak and general price indices showed that they were similar up to 1973 but that teak indices rose faster after 1974. A comparison of the average annual growth rate of teak and general price indices showed that they were similar.

3757 Moonrasarn, S. 1992. **Profit planning for teak plantation case: FIO's industrial plantation**. Proceedings of the Seminar on 50 Anniversary of Hyay-Tak Teak plantation, Bangkok, 5-8 August 1992.

The FIO had executed reforestation since 1989. The first priority is teak in Northern part of Thailand. The execution of industrial teak reforestation will be operated by 12 percent low interest loan. Clear cut and replantation system is considered to be done with rotation of 30 year. Mean Annual Increment will be at 0.5 cubic m/year/rai.

3758 Nair, P.N. 1967. **Economics of forest plantation in Kerala state**. Proceedings of the 11th Silvicultural Conference, Dehra Dun, 1967. Forest Research Institute, Dehra Dun.

The relative profitability of growing teak, eucalyptus and rubber plantations in Kerala state, India is discussed. Teak is almost as profitable as eucalyptus and more profitable than rubber. The economics of various plantations at the end of the specific rotation period are compared and discussed.

3759 Niskanen, A. 1998. **Financial and economic profitability of reforestation in Thailand**. Forest Ecology and Management 104(1/3): 57-68.

The financial and economic profitability of industrial, community and agroforestry based reforestation were assessed in North East Thailand. The profitability was evaluated for plantations using *Eucalyptus camaldulensis* and *Tectona grandis* and agroforestry based reforestation where cassava was intercropped with the tree species.

3760 Ouseph, K.P. 2003. **Should we evict forest encroachers? - a new way of looking at sustainable production of teak timber in Kerala**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Arguing the fallacies of the existing policy on the forestry, forest management and sustainable forest management. It argues for the need of a new perspective on the age-old problem of forest encroachments in

Kerala. Growing teak in forests alone will not be sufficient to meet the growing demands of the state. Attempted to estimate the demand for wood by various sectors and supplies from different sources in Kerala. Highlight the possibility of increasing supply of good quality, teak timber through new policy options, which will also ensure a solution for the problem of eviction of forest encroachments wherever it is impossible.

3761 Parameswarappa, S. 1993. **Teak - how fast can it grow? And how much can it pay?** Myforest 29(4): 231-232.

Tectona grandis in India.

3762 Parameswarappa, S. 1995. **Teak - how fast can it grow and how much can it pay?** Indian Forester 121(6): 563-565.

A brief discussion of teak growth and plantation economics in India.

3763 Pradhan, I.P; Dayal, R; Vasava, S.S. 1976. **Teak plantations in Mahi ravines and their economic evaluation**. Soil Conservation Digest 4(1): 10-16.

Establishment, survival, growth, management and economics of teak plantations in deep ravines are reported.

3764 Pringle, A.M. 1950. **The Enugu Pitwood plantations: Nigeria**. Empire Forest Review 29(3): 238-243.

Of many species tried teak and *Gmelina arborea* have been found useful for mining props and both are grown on a coppice and clearfelling system on 15 year rotation to produce 12 ft. prop.

3765 Rahman, A. 1977. **Profitability of teak plantations under the existing system of management in Bangladesh**. Bano Biggyan Patrika 6(1): 36-50.

The assessment was based on a 60-year rotation of *Tectona grandis* plantations and prices for 1975-76. It is suggested that in order to improve their profitability it will be necessary to improve their management.

3766 Ramnarine, S. 2001. **Proposed royalty rates for teak and pine in Trinidad**. Forestry Division Report, Mimeo: 22p.

3767 Rao, A.L. 1968. **Dry deciduous forests of Andhra Pradesh and their management-past and present**. 9th Commonwealth Forestry Conference, New Delhi, 1968.

The forests are of three types dry teak forests, *Pterocarpus santalinus* forests and dry mixed deciduous forests.

3768 Rao, D.S; Mehar Singh; Shivaraju, B. 1997. **Teak management in Kerala**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 32-37. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

The extraction not conservation was the sole object of teak management, which was continued till 1840s. Prescriptions of Indian Selection System by Sir. Brandis was a milestone in the teak forest management which was developed and practised in the second half of the 19th century with considerable success. Conversion of teak bearing forests into plantations was continued till the discontinuation of clearfelling and selection felling in late 1980s. The first successful teak plantation raised by Sri. Chathu Menon, in Nilambur Valley in 1844, paved the way for establishing large scale plantations.

3769 Rao, Y.S. 1968. **View it as investment**. Indian Forester 94(5): 383-388.

Discusses the requirement of raw material for industry and analyses the economics of growing bamboo, eucalypt and teak. The need for forestry planning based on a proper understanding of economics is emphasized.

3770 Rawat, J.K; Negi, M.S. 1998. **Economic viability of teak plantations in India**. Proceedings of the National Conference on Teak, Jabalpur, India, 25-26 May 1998.

3771 Ribbontrop, B. 1898. **Note on the working plan for the Nilambur valley teak plantations**. Indian Forester 24(5): 163-169.

Remarks on Mr. Lushington's working plan of Nilambur teak plantations are presented.

3772 Ritz, A. 1934. **Comparison of the economic results of the Government teak plantations in the Netherlands, India**. (Dutch; English). Tectona 27: 83-100.

3773 Rodger, A. 1915. **The Myodwin teak plantations, Zigon Division, Lower Burma**. Indian Forester 41(10): 372-377.

The oldest teak plantations of 1862 and 1863 at Myedwin raised by sowings and nursery transplants respectively were described with cost after clearance and burning of existing low jungle. Thinnings carried out and the growing stock of the plantations are dealt with.

3774 Rodger, A. 1929. **Teak plantations in Coorg**. Inspection Tour Note, Madras Forest Department: 14p.

3775 Romeijn, P. 1999. **Green gold: On variations of truth in plantation forestry**. Thesis. Wageningen Agricultural University, Wageningen, Netherlands: 221p. Treemail Publishers, Netherlands.

Green Gold is a study using the Internet as the principal means of the Netherlands Teakwood Investment Program, which offered the Dutch public the opportunity to invest directly in a teak plantation project in Costa Rica. The study discusses how the management of the teak plantations was subsequently certified under the auspices of the Forest Stewardship Council. The programme was pioneered in 1989, and joined by WWF and an insurance and banking company (OHRA) in 1993, when it gained great momentum and huge investments. The book offers an insight into the basics and credibility of forest management certification and forest products labelling and shows how the Internet helps to extract accountability from Trans National Corporations.

3776 Ryan, P.A. 1982. **The management of Burmese teak forests**. Commonwealth Forestry Review 61(2): 115-120.

Natural occurrence and physical conditions of Burmese teak forests are dealt with. Its vegetative associations, silvicultural characteristics and silvicultural systems followed in the Burmese teak forests are also dealt with.

3777 Salleh Mohd Nor; George, A; Tay, S.P. 2000. **High value timber species: Prospects and challenges**. Proceedings of the seminar on high value timber species for plantation establishment teak and mahoganies, Tawau, Sabah, Malaysia, 1-2 December 1998. H.H. Chan; K. Matsumoto, Eds. JIRCAS Working Report 16: 7-16.

Discuss the supply and demand of high-value timber, from the point of view of supplier countries in SE Asia such as Malaysia and Indonesia. Economics associated with initiating and financing plantation projects are discussed.

3778 Sardar, M.G; Deshmukh, A.P; Chandnani, K.N. 1997. **Projections of financial returns in the teak plantations in West Chanda Forest Project Division**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 216-221. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

The paper highlights the different projections of financial returns in teak plantation from thinnings proposed at various stages and which contribute revenue to the Forest Development Corporation of Maharashtra Ltd. The projections reveal that the short rotations are economically more profitable than longer rotations.

3779 Sarlin, P. 1961. **The teak plantations of Togo**. (French). Centre Technique Forestier Tropical, Nogent-sur-Marne: 31p.

Plantation technique, yields, financial returns and usefulness to the local population.

3780 Sathe, P.G; Susaeta, E. 1973. **Formulation and economic assessment of an intensive forestry project in eastern Maharashtra**. 211p. Ford Foundation, New Delhi.

Reports a feasibility study to assess by cost/benefit analysis of managing the large area of neglected forests in south-eastern Chandrapur District. Recommendations include intensive management to exploit and market existing forest produce as economically as possible, and the establishment of mixed plantations of *Tectona grandis*, semal and bamboo on a 50-year rotation.

3781 Saw Eh Dah. 2003. **Sustainable management of teak in Myanmar**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Teak from the natural forests has been a major source of foreign exchange earning for Myanmar for many years. After almost a century and a half of scientific and systematic management with the application of the Myanmar selection system (MSS), the natural teak bearing forests remain in comparatively good extent. With the application of time proven techniques and innovative modern methods, large scale plantations are established on depleted forest lands complementary to the main effort in natural forest management.

3782 Schmidt, P; Wiersum, K.F; Lemckert, D. 1997. **Collaboration between forestry, environment and trade; does the end justify the means?** Nederlands Bosbouwtijdschrift 69(2): 83-86.

Silvicultural and extension aspects are outlined on private investments in teak plantations in Costa Rica.

3783 Schmincke, K.H. 2000. **Teak plantations in Costa Rica - precious woods' experience**. Unasylva 51(201): 29-35.

An account of a commercial enterprise Precious Woods, a predominantly Swiss company operating in Costa Rica aiming to meet the rising demand for teak whilst contributing to sustainable forest development.

3784 Scott, C.W. 1945. **Burma teak today**. Wood 10: 81-84.

Burma provides about two-thirds of the world's output of teak, the total output from that country being about 1/2 million tons of round logs per annum. Half of this outturn comes from the Pegu Yomas between the Irrawaddi and Sittang rivers, before the Japanese invasion, was almost entirely reserved forest and worked on sustained-yield basis by lessees or the Government department. Owing to the vastness of the teak forests and to the lack of transport facilities, it is probable that the Japanese will have done little harm to the main Burmese teak stands.

3785 Sekar, C; Swaminathan, C; Surendran, C. 1993. **Economic analysis of silviagriculture in Tamil Nadu - a comparative study**. Range Management and Agroforestry 14(2): 219-224.

A diagnostic questionnaire survey was conducted of tree growing farmers in Periyar District, Tamil Nadu, to compare the costs and returns from silviculture and agrosilviculture. The agrosilvicultural systems were the most profitable, and provided a sustained income.

3786 Seth, V.S; Kohli, I.S; Jain, C.S. 1978. **A performance appraisal of Madhya Pradesh State Forest Development Corporation through accounting ratios**. Indian Forester 104(12): 797-818.

The Corporation was set up in 1975, with capital from the Central and State Governments. It has been concerned with the establishment of teak and bamboo plantations and a research and development project and a feasibility study on the establishment of forest-based industries. The Corporation's accounts for the three years to 1978 are presented.

3787 Shebbeare, E.O. 1921. **The Bomanpokri teak plantation**. Indian Forester 47(5): 224-226.

With reference to Gamble, the present condition of Bomanpokri teak plantations and an account of the operations carried out is given.

3788 Shyam Sundar, S; Parameswarappa, S. 1997. **Intensive management of teak plantations**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 20-23. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

In Karnataka, about 125,000 ha is under teak plantations of different age gradations. The current average price for good teak logs is Rs.24,500/m3. In teak plantations, the investment comes around Rs.7500/ha in the first year and then Rs.200 to Rs.500/ha in the ensuing years. It is high time to think about to increase the production and productivity of teak stands, managed by the State Forest Department. Measures to be undertaken for improving the production of existing teak stands are suggested. Formation of a Forest Corporation for teak and entrusting it the management of whole teak plantations is proposed.

3789 Simon, H. 1997. **History of teak forest management in Indonesia**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 52-60. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

The experiences gained from the teak forest management in Java, paved the way for development of forest management in Indonesia. Due to economic reasons, the management of teak forest in Central and East Java provinces was under the control of a state owned enterprise, Perum Perhutani, since 1972. The paper highlights the history of management of teak forest under different regeneration systems, viz., overstraten's report or first guideline, Daendel's regulation, Reglement 1829 or third guideline, Blandong system or natural system (fourth guideline), tumpangsari, etc. Also discusses the formulation of guidelines on operational thinning, final harvest, etc.

3790 Singh, J.A. 1959. **Teak forests and their management in Bombay State**. Proceedings of All-India Teak Study Tour and Symposium, December 1957-January 1958, Dehra Dun: 73-75.

3791 Snepvangers, F.W. 1929. **The economic significance of teak forests**. Tectona 22: 215-222.

3792 Soemarso. 1955. **The stand quality factor used in teak forest**. (Indonesian; English). Rimba Indonesia 4(1/2): 38-44.

Outlines a method to determine quality factors of a stand by comparing that with a normal stand at the end of the rotation. Since quality factors of a stand is not influenced by thinnings, this can be used to evaluate and appreciate the main crop.

3793 Srisuko, M. 1977. **Cost and profit estimation in the government's teak plantations**. (Thai). National Forestry Conference, Bangkok: 63-69. Royal Forest Department, Ministry of Agriculture and Cooperatives, Bangkok.

3794 Stebbing, E.P. 1947. **The teak forests of Burma**. Nature 160(4076): 818-820.

A history and valedictory to the forest administration with a warning to the Burmans of their responsibilities.

3795 Steber, B. 1998. **Marketing of teak**. Proceedings of the Seminar on High Value Timber Species for Plantation Establishment - Teak and Mahoganies, Sabah, 1-2 December 1998. JIRCAS Working Report 16: 83-89. H.H. Chan; K. Matsumoto, Eds.

Discussed from the point of supplies of plantation teak from South East Asia, including financial aspects of the marketing, investments as well as harvested teak timber.

3796 Subramanian, K; Mandal, A.K; Rambabu, N; Mammen, C; Nagarajan, B. 1999. **Site, technology and productivity of teak plantations in India**. Technical Bulletin IFGTB-99-1: 11p. Institute of Forest Genetics and Tree Breeding, Coimbatore.

This paper gives an account of teak plantation establishment in different rainfall and soil conditions, the agencies involved in the cultivation of teak and the productivity of the plantations projected by different owners in India.

3797 Sudarmo, M.K. 1957. **System of management for teak in Indonesia**. FAO Teak Sub-Commission, Bandung FAO/TSC-57/22: 2p. FAO, Rome.

Discusses methods of yield regulation, rotation etc.

3798 Sudiono, J. 1991. **An analysis of teak forest existence in Perum Perhutani**. (English; Indonesian). Duta Rimba 17(127/128): 2-18.

An account of teak production forests managed by Perum Perhutani in Indonesia, discussing management, inputs and outputs.

3799 Suksawasdi, S. 1953. **The future of Siamiese teak forests**. (Siamese). Vanasarn 11(2): 5-14.

Deplores the drain on the country's teak forests, points to the chief causes as uncontrolled forest clearance for shifting and permanent cultivation, fires, and illicit felling and suggests remedies.

3800 Tewari, D.N; Susaeta, E. 1973. **Formulation and economic assessment of an intensive forestry project for the Bastar region of Madhya Pradesh**. 47p. Ford Foundation, New Delhi.

Reports a feasibility study of forest development in the region involving improved management of existing forests. Forest inventory and resource data are presented, and an economic assessment is made of the profitability of existing natural stands and plantations including *Tectona grandis*.

3801 Thangam, E.S; Bhadran, C.A.R. 1959. **Teak forests and their management in Madras State**. Proceedings of All-India Teak Study-tour and Symposium, December 1957-January 1958, Dehra Dun: 80-92.

3802 Tint, K. 1999. **Socio economic and environmental conservation potentials of special teak plantation**. (Myanmar Language). Forest Department, Myanmar.

3803 Trevor, C.G. 1924. **A review of the Indian forest management III. Teak**. Indian Forester 50(7): 388-390; Empire Forestry Journal 2(1923).

The method of teak regeneration by clearfelling followed by artificial regeneration with field crops is described and regulation of yield are discussed.

3804 Unwin, R. 1912. **Teak in Togo**. Government Report, West Africa.

3805 Varmola, M.I; Carle, J.B. 2002. **The importance of hardwood plantations in the tropics and sub-tropics**. International Forestry Review 4(2): 110-121; 165-167.

The importance of tropical and subtropical hardwoods in industrial wood production in relation to market opportunities are discussed. Indicative estimates of teak standing volume annually available are presented showing Asia dominating production. Recommendations are made for promoting the establishment of hardwood plantations in the tropics and sub-tropics.

3806 Venkataramana Iyer, K.R. 1932. **Inspection notes of Tinnavelly Division, Madras**. Madras Forest Department.

3807 Walker, H.C. 1919. **The management of teak forest**. Indian Forester 45(11): 561-578.

The Burma experience is discussed and present practice of converting all mixed teak forests to even aged woods is criticised.

3808 William Logan. 1889. **A collection of treaties, engagements and other papers of importance relating to British in Malabar**. Government Press, Madras: 319p.

3809 Wind, R. 1928. **The economic importance of Java teak forests**. Tectona 21: 459-506; Roundschau 1: p350.

3810 Winkle, R van. 1920. **A teak plantation**. Indian Forester 46(6): p318.

Details of growth figures of a plantation in Palamau division, Bihar are given.

3811 Wiroatmodjo, R.S; Effendi, R.M. 1955. **Financial rotation of teak and profit**. Rimba Indonesia 4(6-8): 249-259.

Calculations have proved that the financial rotation of teak with a higher rate of interest is short. To put this into effect a sound forestry technique and its social function have to be taken into full consideration.

3812 World Bank, Washington. 1976. **Social cost benefit analysis: A guide for country and project economists to be derivation and application of economic and social accounting prices**. World Bank Staff Working Paper 237: 142p. World Bank, Washington.

3813 Wyatt Smith, J. 1945. **The Ibadan fuel plantations**. Farm and Forest 6(2): 95-99.

Teak has been the principal species planted with other species on slopes. Revenue and establishment costs are discussed.

Go top

Management

(See also 1947, 2293)

3814 Boomgaard, P. 1992. **Forest management and exploitation in colonial Java, 1677-1897**. Forest and Conservation History, USA 36(1): 4-14.

3815 Browne, R.S. 1929. **Revised working plan for the Nilambur Valley 1928-29 to 1937-38**. Madras Forest Department.

3816 Centeno, J.C. 1997. **The management of teak plantations**. Tropical Forest Update 7: 10-12.

3817 Champion, H.G. 1962. **Report to the Government of Thailand on a working plan for the Mae Ngao forest**. Expanded Technical Assistance Program Report 1540: 111p. FAO, Rome.

Deals with proposed forest management including working plan for teak working circle, silviculture, yield regulation, stand regeneration and forest protection. Includes recommendations to Government.

3818 FAO. 1957. **Note on production of teak: Indonesia**. FAO Teak Sub-Commission, Bangkok FAO/TSC-57/20: 2p.

Gives trend of production from 1938 to 1956 and suggestions are provided for increasing production through replanting unproductive stands, retionalization of the maintenance and protection of plantations, conversion of rejected wood left unused in forest by sawmills and using the waste of cutting areas, ie., branches and trunks and at sawmills for hardboard and chipboard.

3819 FAO. 1967. **Production outlook for teak in Burma**. FAO Teak Sub-Commission, Rome FAO/TSC Rome FO:T/67/6: 5p.

The ecological requirements of teak are stated and the total planted area so far is 95,000 acres pure and 15,000 acres in mixture and its rotation is 40-60 years. Natural teak forests managed on sustained yield basis on selection system on a 30 year cycle, with a yield of 450,000 tons and 90 percent of this is

exported. Measures to increase production are suggested.

3820 FAO. 1967. **Production outlook in the old teak growing countries**. Asia-Pacific and African Forestry Commission, Teak Sub-Commission, Rome FO:T 67/7: 12p.

Natural teak forests occupy about 13 percent of total forest areas of India. Its climatic conditions, classification of teak forest types, soil and nutrient requirements, international provenance trials, progress in seed orchard work, management, logging and transport methods are discussed. Utilization of teak and mechanization problems are outlined and current and future research programmes are indicated.

3821 FAO. 1985. **Intensive multiple use forest management in the tropics**. FAO Forestry Paper 55. FAO, Rome.

3822 FAO. 1986. **Special study on forest management, afforestation and utilization of forest resource in developing regions, Asia-Pacific**. APM Case Study, Bangkok, Thailand, Field Document 12(2). FAO Regional Office for Asia and the Pacific.

3823 Gyi, K.K. 1995. **Management status of natural teak forests**. Proceedings of the 2nd Regional Seminar on Teak, Yangon, Myanmar 29 May-3 June 1995.

3824 Hopwood, S.F. 1932. **On teak plantation in Burma**. Annual progress report of Forest Administration in Burma 1931-32: 279p.

Describes forests, so far reserved and fire protection measures adopted with costs. Teak is planted in 2200 acres.

3825 Houaye, P. 1993. **Variability of teak plantations in Benin**. (German). Gottinger Beitrage zur Land und Forstwirtschaft in den Tropen und Subtropen 85: 170p. Institut fur Pflanzenbau & Tierhygiene in den Tropen & Subtropen, Gottingen, Germany.

The biological and ecological features of teak are reviewed, and details given of the extent and management of the teak stands in Benin. Detailed investigations were made of the development and variation of individual-tree parameters and stand parameters in plantations on two sites. The results confirm the unsatisfactory structure of the Benin stands.

3826 Kartosoedarmo, M. 1956. **Management system of teak forest**. Country Report on Teak. FAO, Rome.

3827 Kesarcodi, S.N. 1934. **Revised working plan for the Haliyal teak pole forests of Kanara North Division**. Government Printing, Mysore and Mysore Forest Department.

3828 Koelmeyer, K.O. 1957. **Teak plantations in Ceylon**. Ceylon Forester 3(2): 178-184.

Includes climatic and site data, methods of formation, injuries, and volume tables for existing plantations totaling ca. 9100 acres.

3829 Kolison, S.H, Jr; Granskog, J.E; Walker, R; Busbu, R.L. 1997. **Institutional and economic factors influencing the management of teak plantations in the Republic of Trinidad and Tobago**. Asia Life Science 6(1/2): 16p.

3830 Kyaw, S. 2000. **Historical review of teak forestry in Myanmar**. Proceedings of the 3rd Regional Seminar on Teak, Yogyakarta, Indonesia, 31 July-4 August 2000.

3831 Lushington, A.W. 1896. **Report and working scheme of the Nilambur teak plantations**. Kerala Forest Department, Trivandrum.

3832 Mammen, C. 1993. **History of forest management in Kerala**. KFRI Research Report 89: 114p. Kerala Forest Research Institute, Peechi.

An attempt has been made to discern the main trends in forest management in Kerala. Three broad phases in forest management has been identified and they are the rise of forestry, the period of turbulence and change and the ascent of conservation. The major achievements during the period of the rise of forestry are the reservation of forests, the perfecting of teak planting techniques and initiation of systematic management on the basis of carefully prepared working plan.

3833 Mammen, C. 2001. **Economics of forest plantations in Kerala**. KFRI Research Report 210: 50p. Kerala Forest Research Institute, Peechi.

The study examined the productivity and profitability of different forest plantations in Kerala. Teak plantation managed on a mean rotation of 58 years is reported to have the mean annual increment of 2.516 m3 ha(-1)year(-1). The internal rate of return of teak plantations was 25.9 per cent.

3834 Martin, B; Kadio, A; Offi, K. 2000. **Towards intensive management of teak plantations in Cote D'Ivoire**. Site, technology and productivity of teak plantations. Proceedings of International Seminar, Chiang Mai, Thailand, 26-29 January 1999: 151-160. T. Enters; C.T.S. Nair, Eds. FORSPA, Bangkok.

Teak management has been modernized, vegetative propagation techniques allowing rapid use of superior clones have been introduced, management of existing plantations has been improved and restocking after final harvesting has been accelerated. Discussed the present status of teak plantations and intensive management of existing plantations and intensification of new plantation establishment in Cote-D'Ivoire.

3835 Mobbs, E.C. 1941. **The early history of Indian forests**. Indian Forester 67(1): 241p.

3836 Mungkorndin, S. 1970. **On the management of teak forests and other non-teak forests in Thailand**. (Thai). Proceedings of 3rd National Forestry Conference, Royal Forest Department, Bangkok: p79.

Describes intensive measures undertaken in recent years for the management of teak forests in the interest and as per requirements of National development plan.

3837 Nagdev, D.P. 1949. **Nilambur teak forests: The plantation of my delight**. Indian Forester 73(2): 467-468.

A brief historical background of the Nilambur teak plantation is given and described the regeneration technique.

3838 Nair, C.T.S; Mammen, C; Muhammed, E. 1984. **Intensive multiple use forest management in the tropics: A case study of the evergreen forests and teak plantations in Kerala**. KFRI Research Report 22: 184p. Kerala Forest Research Institute, Peechi.

Deals with the management of the evergreen forests and teak plantations in Kerala. The two major types of forest that occur in the study area are evergreen forests and moist deciduous forests. Evergreen forests are worked for wood production under a selective felling system. Moist deciduous forests are converted into teak plantations by clearfelling. Most of the teak plantations contain a large number of commercially valuable species. Teak plantations are raised under the taungya system in which cultivators undertake all the post-planting operations for a period of about two years.

3839 Nair, C.T.S; Mammen, C. 1985. **Forest management system in the tropical mixed forests of India**. FAO Forestry Paper 89. FAO, Rome.

3840 Nair, C.T.S; Souvannavong, O. 2000. **Emerging research issues in the management of teak**. Unasylva 51(201): 45-54.

The evolution of priorities and institutional arrangements for research on teak management and utilization is discussed in the context of changing management scenarios and the increasing involvement of the private sector.

3841 Nath, B; Chittranshi, V.N. 1967. **Impact of intensive forest management on the growth behaviour of teak in the teak high forests of Narshimpur Forest Division, Madhya Pradesh**. Proceedings of the 11th Silvicultural Conference, Dehra Dun 1967, Item III.C.(1). Forest Research Institute, Dehra Dun.

An attempt is made to correlate past treatments on the growth rates of converted and unconverted teak in the teak high forests of Narshimpur forest division of Madhya Pradesh. The converted teak contains a series of normal age gradations upto thirty eight years showing the effect of past management practices. The unconverted teak did not receive any intensive management during early 30-40 years of development and forms the basis of comparison of the growth factors of converted teak.

3842 Niemmich. 1896. **Management of teak in Java**. Zeitschrift fur Forst. U-Jagdwesen 28: 714-721.

3843 Nieuwenhuyse, A; Hengsdijk, H; Bouman, B.A.M; Schipper, R.A; Jansen, H.G.P. 2000. **Can forestry be a competitive land use option? Model simulations from humid tropical Costa Rica**. Forest Ecology and Management 137(1/3): 23-40.

Model simulations were carried out to study options for managed natural forest and *Gmelina arborea* and teak plantations, on land suited for agriculture in the humid tropical Atlantic lowlands of Costa Rica. The results indicated that teak and gmelina plantations are attractive land use options, while managed natural forest is not.

3844 Nonhare, B.P. 2003. **Maniram teak plantation 1891 - a state heritage of Chattisgarh**. Indian Forester 129(5): 661-662.

The history of the teak plantations dates back to 1891 which is the oldest teak plantation of Chattisgarh state. Shri Maniram Gond then the forest guard during British rule was the person responsible for raising this plantation. In honour of the late dedicated forester, The Forest Department of Madhya Pradesh named the plantation as Maniram Teak Plantation 1891. The estimated value of teak trees of this plantation comes to Rs.2,05,53,000.

3845 Pakpahan, A; Ismuyatmono, Y. 1982. **Absorption of labour in teak forest management in Cepu forest District**. (Indonesian). Duta Rimba 8(52): 41-43.

3846 Peluso, N.L. 1991. **The history of state forest management in colonial Java**. Forest and Conservation History 35(2): 65-75.

The control of forest land, teak and labour is discussed in relation to the two main periods of Dutch influence and rule, the mid-17th century to 1799, when much of Java was under the influence of the United East India Company and 1814-1940, when Java was ruled by the Dutch colonial state.

3847 Petty. 1933. **Thana Malki teak working plan, Bombay**. Government Report, Forest Department, Bombay.

3848 Porter, H.J. 1895. **The management of forests containing teak**. Indian Forester 21: 141-142.

The rapidly grown moisture teak of Nilambur and slow grown dry Annamalai hill teak forests are compared and the problems of silviculture and management of these plantations are discussed.

3849 Prabhu, H.N. 2001. **New management options for improving the productivity of teak plantations in Kerala**. Tropical Forestry Research: Challenges in the New Millennium. Proceedings of the International Symposium, Peechi, India, 2-4 August 2000. R.V. Varma; K.V. Bhat; E.M. Muralidharan; J.K. Sharma, Eds: 165-167. Kerala Forest Research Institute, Peechi.

The paper discusses the reasons for declining productivity, steps for improving the same and the latest measures taken by the Kerala Forest Department to improve the productivity of teak.

3850 Prasad, R.S.R. 1995. ***Tectona grandis* - elite management**. Indian Forester 121(6): 558-562.

Data are presented and discussed on the commercial management of teak plantations and its financial aspects in India.

3851 Pratiwi; Lust, N. 1994. **Teak (*Tectona grandis* Linn.f.) forests in Java, Indonesia. Plantations, management and policy**. Silva Gandavensis 59: 97-118.

An overview is given of forest policy and management, environmental conditions, silviculture, distribution and area of teak forests in Indonesia. The taungya system and a daily wage system are both considered to be valuable social and economic factors for people in areas surrounding teak forests. Indirect government policies as well as those aimed at teak forest resources, could also help to maintain teak forests and production in Indonesia on a sustainable basis.

3852 Rahman, A. 1982. **The strategy of long-term programming for teak plantations in Bangladesh**. Bano Biggyan Patrika 11(1/2): 48-55.

Various yield data are given and compared with those for other countries, against which Bangladesh teak rates poorly. Based on rates of return it is concluded that teak should not be planted on sites of site index 30. The estimated teak requirement by 2040 is about 5 percent of the total expected yield from the hill forests. Five strategies with respect to sites, plantation area, rotation, thinning and stocking are outlined to give a long-term programme consistent with socio-economic goals and national forest policy.

3853 Ramakrishna, A. 1956. **Teak in Nallamalais**. Andhra State Souvenir of Andhra Pradesh State Forest Department, Hyderabad: 65-68.

Gives a short description of the forests and the method of raising plantations.

3854 Ramakrishna, A. 1957. **Progress of teak plantations in the Nallamalais during the last half a century and their future**. Indian Forester 83(7): 462-464.

Indicated briefly the general requirements of teak for soil, climate etc. The progress made in raising teak plantations in Nallamalais, Andhra Pradesh has been discussed. Importance of fire protection elucidated.

3855 Ranganathan, P.B. 1982. **Seventh working plan for the Nilambur Forest Division,**

1982-1983 to 1991-1992. Kerala Forest Department, Trivandrum.

3856 Samapudhi, K. 1957. **The forests of Thailand and forestry programmes**. Royal Forest Department, Bangkok R.20: 35p.

3857 Schirie, A. 1961. **The achievements of the forest service in the province of Majunga (Madagascar)**. (French). Centre Technique Forestier Tropical, Nogent-sur-Marne: 12p.

A brief account of the afforestation using the species which include teak and the erosion control.

3858 Simon, H. 1989. **Social forestry as a tool for management of teak forests near heavily populated areas: A case of Java**. Southeast Asian Regional Center for Graduate Study and Research in Agriculture, Philippines: 193-207.

3859 Simon, H. 2000. **The evolvement of teak forest management in Java, Indonesia**. Potentials and opportunities in marketing and trade of plantation teak: Challenge for the new millennium. Proceedings of 3rd Regional Seminar on Teak, Indonesia, 31 July-4 August 2000: 83-90. E.B. Hardiyanto, Ed.

3860 Soemaatmadja, S.A.S. 1982. **Teak forest conservation in Perum Perhutani's working circles**. (Indonesian). Duta Rimba 8(53): 9-17.

3861 Soemaatmadja, S.A.S. 1982. **The sustained yield of teak forest management in the Perum Perhutani area**. Forest Magazine of Perum Perhutani, Jakarta 53.

3862 Strugnell, E.J. 1932. **The teak forests of Java**. Empire Forestry Journal 11: 34p.

3863 Varmah, J.C. 1976. **Forest management in Andamans**. Indian Forester 102(2): 73-85.

Briefly describes the eleven forest types in the Andaman Islands, the history of forest management, artificial regeneration of plantation species and the natural regeneration of evergreen and deciduous forests. The potential production of some Andaman timbers, trends towards more intensive forest management, and the effects on the environment of the increased activity are discussed.

3864 Wardono Saleh; Fattah, H.A; Poedjoraharjo, D.S. 1997. **Culture of teak plant by Perum Perhutani**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 12-14. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Perum Perhutani, a state-owned enterprise of Java, Indonesia, has 600,093 ha of teak forest under its management. Per annum production of teak is about 700-800 m3. 'Thumpangsari' and 'Banjar harian' planting systems are practised for raising teak plantations. Fast growing multipurpose tree species are raised along with teak plants to prevent soil erosion, preserve soil fertility and to protect against pests, diseases and external interferences. Methods of regeneration of teak, preservation and thinning, and problems confronted in teak plantation management are highlighted.

3865 Watson, H.W.A. 1916. **Teak working plans in Burma 1. Past working plans**. Indian Forester 42(1): 4-17.

The basis of proposals in the past were described and critically examined and probable trend in the future working plans is outlined. The details of working under girdling system and regeneration artificially of teak in bamboo flowered areas is discussed and suggestions are made.

3866 Winters, R.K. 1975. **Forestry beginnings in India**. Journal of Forest History 19(2): 82-90.

An account of the history of the public forest administration and forestry education upto 1947, emphasizing the importance of the teak trade in the creation of the administration and of Indian forestry as the first major expansion of professional forestry outside Germany and France and into the tropics.

Go top

Marketing

(See also 3743, 3956)

3867 **Reduction of the duty on teak timber brought down to Moulmein from foreign territory**. Indian Forester 7, 1882: 330-333.

3868 **Teak wood**. Indian Forester 9, 1883: p583.

Gives an account of the good qualities of teak wood and recommends its use for a variety of purposes and requirements of wood.

3869 **The further development of the teak trade**. Indian Forester 14, 1888: 282-285.

3870 **The teak trade**. Indian Forester 18, 1893: p401.

Gives export figures of teak from Moulmein to Western Europe and Middle East mainly U.K., West Europe and Egypt.

3871 **The teak trade of Chiangmai**. Indian Forester 19, 1893: 39-41.

The outlet for Chiangmai teak timber is through Bangkok and Moulmein. The problems of trade are discussed.

3872 **The teak trade in Siam**. Indian Forester 21, 1895: 431-432.

Gives an account of extraction and floating methods adopted in the principal teak bearing forests of Siam. The method of extraction and transport and problems of rafting, seasons and theft of rafts are also discussed.

3873 **The teak trade of Chiangmai in Siam for 1894**. Indian Forester 21, 1895: 12-15.

Gives quantitative figures of extraction and export of teak wood from Chiangmai and also discusses problems encountered.

3874 **Consumption of teak in Europe**. Bulletin Soc. For., Belgium 5, 1898: p50.

3875 **Teak and the French timber trade**. Bulletin Soc. For., Belgium 6, 1899: p431.

3876 **Teak trade in Bangkok, Siam during 1898**. Indian Forester 26(2), 1900: 96-97.

3877 **Teak timber exports**. Indian Forester 32(8), 1906: p422.

A short note on the export figures of teak from India, Burma, Siam and Java.

3878 **Note on trade of teak timber in Netherlands**. Tectona 4, 1911: 752-763.

Gives production and teak trade from 1899 - 1908-09.

3879 **East India teak**. Indian Forester 41(5), 1915: 169-170.

The note describes the impact of world war I on teak trade.

3880 **Teak and other curls or crotches**. Indian Forester 57(5), 1931: 234-237.

A note received from Timber Adviser to the High Commissioner of India on the possibilities of working up a trade in curls of teak and other Indian timbers with observations and remarks by M/s. Leary and Company.

3881 **On net price of teak: Bori forests, Hoshangabad**. Forest Research in India and Burma 1941/42, Part I, 1943: p151.

Investigations have shown that the net price per cu.f. for teak in the Bori for forest of Hoshangabad division varies directly with age and size of tree; the prices per cu.ft. continues to increase with age upto 120 years.

3882 **Burma teak exports**. Timber Trade Journal 243(4499), 1962: p62.

The Director, Marketing and Milling of the State Timber Board, Rangoon, presents the exports to 19 countries in tons.

3883 Altona, T. 1922. **New Guinea teak and no Hindoos**. (Indonesian; English). Tectona 15: 612-621.

Teak has been found up to end of the 19th century in New Ireland and in South Papua. Since climate is not favourable for natural growth of teak in the locality and the Hindoos traveled to these places, teak is considered to be imported there by Hindoos.

3884 Anuwatanawanaraksa, P. 1967. **Duty-fees paid on each teak tree**. (Thai). Proceedings of the First Forestry Conference, Royal Forest Department, Ministry of Agriculture, Bangkok 107: 5-6.

The author discusses the exploitation of teak wood from forests and the wastage involved in it. He recommended levying a special duty or fees on teak tree.

3885 Argal, A; Berry, N; Sood, L.K; Chawdhry, P.K; Shukla, P.K. 2003. **Timber trading trends in Madhya Pradesh**. Indian Forester 129(8): 1009-1012.

Results are presented of the study conducted to analyze the market price variation of seven timber species which include *Tectona grandis* .

3886 Baghel, L.M.S; Behari, B; Gupta, A. 1999. **Price trends of fuelwood: A comparative analysis of Madhya Pradesh and Maharashtra**. Journal of Tropical Forestry 15(4): 302-310.

Comparative price trends of fuelwood in markets in Madhya Pradesh and Maharashtra were studied by collecting price data on a quarterly basis and estimating simple average quarter growth rates. The mean price and temporal character of variability exhibited the same phenomenon. Correlation coefficients between the markets showed that prices of fuelwood were highly correlated between the markets during the period under study. The price of teak fuelwood had the maximal increase over all three markets studied.

3887 Black, S.J. 1901. **Report on the teak trade in Chiangmai, Siam**. Indian Forester 27(3): 136-140.

The exports and output from 1899 compared with 1898 and causes of decrease in 1899 reviewed.

3888 Bracamp, E.H.B. 1916. **Why are the teakwoods of Manggar Telawa en Tanggoeng zoo cheaper ?** Tectona 9: 479-481.

3889 Brascamp, E.H.B. 1914. **Survey of the results of the 1st semester of 1914 etc., on teak trade and exploitation**. (Indonesian; English). Tectona 7: 873-885.

3890 Brascamp, E.H.B. 1915. **The Siamese teak wood trade again**. Tectona 8: 71-72.

3891 Brascamp, E.H.B. 1916. **An old method for teak trade in Siam**. (Indonesian; English). Tectona 9: 142-143.

3892 Brascamp, E.H.B. 1917. **The meaning of East India Company in relation to export trade of teak in 1790**. (Indonesian; English). Tectona 10: 581-583.

3893 Brascamp, E.H.B. 1919. **The contract of teak delivery by Denmark from 1673**. (Indonesian; English). Tectona 12: 386-390.

3894 Butterwick, A.J. 1915. **Teak after the war: Teak wood**. Indian Forester 41(12): 503-504.

Quoting from scientific American reports increased utilization of best grade teak for construction of modern war ships lost in war and supplies from both Burma and Siam cannot meet this demand, hence prices are going to be up.

3895 Carlisle. 1901. **The teak trade of Bangkok and district**. Indian Forester 27: 187-190.

Giving export market of teak for last 10 years, discusses the prospects and problems of export trade.

3896 Chepsithar, S. 1955. **Thailand teak exports**. Bangkok Chamber of Commerce Journal 9(3).

3897 Dah, Saw Eh; Baw, Shwe. 2000. **Regional marketing and trade**. Proceedings of the 3rd Regional Seminar on Teak, Yogyakarta, Indonesia: 1-4.

3898 De'ath, C. 1992. **A history of timber exports from Thailand with emphasis on the 1870-1937 period**. Natural History Bulletin of the Siam Society 40(1): 49-66.

The history of the Thai forests is largely the history of teak and other non-floatable hardwoods. This paper reviews how the Thai forest resource was depleted over the period 1870-1937. The tables are accompanied by information on the political, ecological and economic factors affecting production and exports during particular periods. A final overview assesses the effectiveness of certain forest policies and the role of the British in the exploitation process.

3899 Doorn, A van. 1926. **A note on the production and price policy for the Government teak exploitation**. (Indonesian; English). Tectona 19: 469-480.

The restriction of timber output in relation to price policy of Government Departments. Proposes a method of sub-division of costs: (a) raising of teak forests and maintenance, (b) cost of harvesting and discusses which costs are to be included under a and b, and (c) staff and need to analyse costs of working is stressed.

3900 Duyfjes, J.J. 1915. **The export of teakwood from Asia to Europe**. Tectona 8: 44-68.

3901 FAO. 1956. **Export and trade in teak of Thailand**. FAO Teak Sub-Commission, Bangkok FAO/TSC-56/2: 2p.

Statistical records after world war II show that teak production amounted to 295,000 cubic meters per year of which some 78,000 cubic meters are exported.

3902 FAO. 1957. **Note on trade of teak in Indonesia**. FAO Teak Sub-Commission, Bangkok FAO/TSC-57/21: 2p.

Trade figures and export quantities from 1938 to 1956 are given, with a note on the prevailing prices of 1956 for different items of use of teak.

3903 FAO. 1960. **Teak production, trade and prices: Note by the secretariat**. FAO Teak

Sub-Commission, New-Delhi FAO/TSC-60/5.1: 4p.

The production, trade and prevailing prices of teak in Burma, India, Indonesia, Laos and Thailand are given in tables, with suitable explanations.

3904 FAO. 2002. **Market for high value tropical hardwoods in Europe**. FAO, Rome.

3905 Gallant, M.N. 1957. **Teak wood trade. Report to the Government of Burma**. Expanded Technical Assistance Program, FAO, Rome 692, 74p.

Gives data on Far East Teak wood supply, geographic distribution, quality standard, production, supply and demand and describes the post-war potential, international markets and marketing.

3906 Glass, J.B. 1949. **The teak trade**. Review of Timber Development Association 2(6): 9-11.

3907 Glass, J.B. 1953. **The teak (Tectona) outlook**. Timber Trade Journal June 2: 85-86.

3908 Gyaw, U.O. 1949. **Burma teak lease**. Burma Market Review 3(3): 67; 69-71.

3909 Harding, L.O.B. 1950. **The Burma teak trade**. Timber Trade Journal 195(3875): 877-878.

3910 Hauxwell, T.A. 1905. **The teak timber trade of Burma**. Indian Forester 31(11): 618-635.

Discussing the diminished supply and high prices of teak over past two years, the author gives imports into Europe market of last 16 years (1889-1904) compared with total exports from Burma and Siam and considers increased export of Siamese teak to India is detrimental to Burma.

3911 Helles, F. 1973. **Denmark's supply of tropical timber**. (Danish). Traeindustrien 23(6): 50-56.

Presents results of an analysis of total imports and exports in the period 1961-70 of tropical round timber, sawn timber, veneer and plywood from Africa, Asia and Latin America, and a breakdown into mahogany, teak and other tropical hardwoods.

3912 Hofseus, C.C. 1907. **The teak trade in Siam**. Beiheft zum Tropenfflanzer, December 1907.

3913 Iamchandra, H. 1968. **Teak marketing condition in Thailand**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Source of production is mostly in northern Thailand and estimated the forest area, extraction, consumption and exports from the Thailand.

3914 Jen, I.A; Wu, W.Y; Chen, L.C; Tu, S.H. 1997. **An analysis of the current situation of the wood flooring market in Taiwan**. Taiwan Journal of Forest Science 12(4): 451-458.

The study analysed market characteristics and purchase attributes of wood flooring in Taiwan.

3915 Krishnankutty, C.N. 1989. **Long-term price trend of timber in Kerala**. Indian Journal of Forestry 12(1): 7-12.

An analysis of price trends at timber auctions in Kerala Forest Department depots from 1956-57 to 1984-85 showed that general trends were similar for the 8 species studied which include teak. The prices initially decreased slightly to 1966-69 and then increased until 1976-77, then increase rapidly.

3916 Krishnankutty, C.N. 1990. **Demand and supply of wood in Kerala and their future trends**. KFRI Research Report 67: 84p. Kerala Forest Research Institute, Peechi.

This study is an attempt to estimate the demand for wood by various sectors and supply from different sources in Kerala during the year 1987-88. Future trends in the demand and supply of wood upto the year 2004-05 are projected based on certain assumptions. Pattern of growing stock distribution of trees in homesteads is anlayzed to estimate the stock and to understand the species preference. Field surveys were carried out for estimating the quantity of wood used by households in rural areas for construction, furniture, etc., by small industries as timber, fuelwood and charcoal, by households in urban areas, teashops, restaurants, etc. as fuel; as well as for estimating the growing stock of trees in homesteads. Anjily, teak and matty are the species preferred among trees grown for wood.

3917 Krishnankutty, C.N. 1997. **Demand, supply and price of teakwood in Kerala**. Ph.D Thesis: 206p. Calicut University, Kerala.

3918 Krishnankutty, C.N. 1998. **Timber price trends in Kerala**. KFRI Research Report 160: 51p. Kerala Forest Research Institute, Peechi.

Statistics are presented on the price trends of species including teak in Kerala.

3919 Krishnankutty, C.N. 2001. Forecasting of teak prices in Kerala State, India using autoregressive integrated moving average models. Indian Journal of Forestry 24(2): 119-122.

Based on time series of average annual current prices of teak in girth classes 1, 2 and 3 in Kerala State is studied. Future prices were predicted with 95 percent confidence limits for the years up to 2015-16 using autoregressive integrated moving average models.

3920 Krishnankutty, C.N. 2001. **Teak price trends in Kerala State, India**. Indian Journal of Forestry 24(1): 1-7.

This paper examines the long term trend in prices of teak in five girth classes in Kerala and compares the price trend with those of other timbers. The analysis showed that the real prices of teak and other timbers declined moderately during the period from 1956-57 to 1968-69. The prices again showed an increasing behaviour till 1983-84. The rate of increase was drastic during the period from 1977-78 to 1993-94. Since then, while prices of teak continued to increase, prices of other timbers showed a decline.

3921 Krishnankutty, C.N. 2002. **Factors influencing teak prices in Kerala**. Indian Journal of Forestry 25(1): 26-29.

The paper examines the factors that influence the long-term change in the real prices of teak sold in auction in the Forest Department depots in Kerala State. Autoregression analysis showed that the real price of teak in a year was closely related to its preceding year's real price, indicating a successive dependence which partly influence the trends in real prices. It was found that the real price was not related to the production of teak in the current year, but inversely related to one year lagged production. It indicates that a reduction in production in the previous year follows an increase in the current year's real price.

3922 Kunsi, E.D; Wechel, G.L Te. 1924. **Combined corporations for the wholesale trade of teak in Java**. (Dutch; German; English). Tectona 17: 141-150.

A combined corporation incorporating timber traders and Government is suggested for the whole of output of the teak fellings in Java. The combination may contribute to saving of forestry personnel in storage and sale of timber to private business.

3923 Latham, B. 1954. **The growth of teak trade. 1. The forests of Western India**. Wood 19: 371-373.

3924 Latham, B. 1954. **The growth of the teak trade 2. Establishment of plantations**. Wood 19: 415-417.

3925 Latham, B. 1954. **The growth of the teak trade. 3. The mid-nineteenth century**. Wood 19: 451-453.

3926 Latham, B. 1954. **The growth of the teak trade. 4. Burma and Siam**. Wood 19: 504-506.

3927 Latham, B. 1957. **Timber, its development and distribution: A historical survey**. G.G Harrap and Company Limited, London: 303p.

Contains sections on the use of timber and the timber trade from ancient Egypt to the present day, the Baltic, U.S.A. and Canada, the Spanish main and mahogany, teak and the E. India Company, oak, sawmilling, the carpenter, timber houses and halls, wooden ships.

3928 Merton, C.G. 1903. **Hardwood marketing - report to the Government of Indonesia**. FAO/EPTA Report 1661. FAO, Rome.

Gives recommendations on wood grading and deals with teak on economics of log transportation and wood processing. Reviews the present domestic and export and its development.

3929 Moonrasarn, S. 1992. **Thailand's teak: Import and export 1982-1991**. Proceedings of the Seminar on 50 Anniversary of Huay-Tak Teak plantation, Bangkok, 5-8 August 1992.

3930 Niloufari, P; Tamolang, F.N. 1979. **Evaluation of tropical woods in the Iranian market**. Wood quality and utilization of tropical species. Proceedings of IUFRO conference, Laguna, 30 October-3 November 1978: 157-163. Forest Products Research and Industries Development Commission, Laguna, Philippines.

Trade names, source, appearance, physical and mechanical properties, and uses are tabulated for sixteen tropical timbers including teak imported into Iran.

3931 Rahman, A. 1981. **Price-size relationship and rate of return from teak plantations in Bangladesh**. Bano Biggyan Patrika 10(1/2): 44-48.

Two regression equations were tested to explain price changes in response to size variation in teak logs, using data from randomly selected teak merchants in Chittagong.

3932 Rai, S.N. 1987. **Steep rise in timber prices**. Myforest 23(1): 111-115.

Data are presented showing prices obtained for timber sales of 10 important species including teak from 1970 to 1985, at Dandeli, one of the major timber depots in Karnataka. Strong recommendations are made for increased wood production, increased efficiency of utilization and preservation of wood already in use.

3933 Soedihardjo, E. 1977. **The conditions of raw log materials and their influence on export yield of teak sawn timber**. (Indonesian; English). Duta Rimba 3(18): 14-25.

3934 Somaiya, R.T. 2003. **Teak wood trade in India**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Since 1982, when cutting of teak from native forests was restricted, Indian processing enterprises and traders have been depending on imported teak logs. Currently, West African and Central American countries have been the major suppliers of plantation teak. And there has also been a shift from teak to other durable hardwoods. It is suggested that if quality of teak timber from sustainable sources does not improve, the market will shrink further to the detriment of teak trade in India as well as overseas. Plantation technology needs to be reviewed to get better quality of wood from teak plantations.

3935 Suri, S.K. 1973. **Comparative price trend studies of five commercially important timber species logs - Narainpur depot (Madhya Pradesh)**. Indian Forester 99(8): 510-515.

On the basis of prices obtained during auctions at Narainpur depot, price trends for second-grade timber logs of *Tectona grandis* and other species are compared and discussed. Results showed that logs of *T. grandis* fetch much higher price than logs of the other species, and also that there is a definite trend in price increase with increase in girth for all species.

3936 Suri, S.K. 1974. **Price trend studies of teak logs, Taku Depot (Madhya Pradesh)**. Indian Forester 100(4): 235-245.

An attempt was made to analyse price trends for second-grade logs of *Tectona grandis*, based on data from auctions at Taku Depot in 1970-71 and 1971-72.

3937 Tewari, D.N. 1995 . **Marketing and trade of forest produce**. 140p. International Book Distributors, Dehra Dun.

Marketing and trade of different species including teak is dealt with.

3938 Thirawatana, S. 1954. **The position of timber exports from Thailand**. (Siamese). Bulletin of Royal Forest Department, Ministry of Agriculture, Bangkok R.15: 190p.

A detailed account of timber exports from Thailand is given which also include the following topics: quantity of teak exported compared with other species, present demand for hardwoods and comparison between the characteristics of Thai and foreign timbers.

3939 Tiffani, F. 1926. **Indian teak exports**. Indian Forester 52(10): 538-540.

Reports majority of exports from Indian ports are teak and comments on specific superior characteristics of teak over native timbers.

3940 Timber Industry Development Division, Ghana Forestry Commission. 2003. **Report on export of wood products, March 2003**. Timber Industry Development Division, Ghana Forestry Commission.

3941 Tottenham, W.F.L. 1905. **The teak trade and forest conservation in Siam**. Indian Forester 31(8): 464-471.

3942 Varangis, P. 1990. **How integrated are tropical timber markets?** International Economics Department, World Bank, Policy, Research and External Affairs Working Papers WPS 465: 25p.

Data were analysed to test whether in the long run tropical timber prices move together in spite of multiple species and products, and regional trade patterns. Time series of data covering 1956-1963 to 1989 were tested for logs of species including teak.

3943 Warta, A.J. 1926. **Export of teak (*Tectona grandis* Linn.f.) from the Netherlands In-**

dies, British India and Siam. (Dutch; English). Tectona 19: 151-169.

A comparison of the export of teak from the three countries is made.

3944 Warta, A.J. 1927. **Position of Java teak on the world market**. (Dutch; English). Tectona 20: 36-53.

Discusses the factors responsible for lowering of the export trade of teak in Java.

3945 Westra, J.G. 1930. **The sale of teak thinnings**. (Dutch; English). Tectona 3: 641-658.

Go top

Wood Industry

(See also 4394)

3946 **Teak industry of Siam**. Indian Forester 27(10), 1901: 529-533.

The teak industry of Siam between Menam and Mekong rivers in Northern Siam is described, together with details of extraction and transport.

3947 **The teak industry of Siam**. Imperial Forestry Institute Bulletin 26, 1928: p102.

Review of the book by the Government of Siam, Department of Commerce and Communications which describes the condition of teak forests of Siam together with the history of the industry.

3948 **The teak industry of Siam**. Indian Forester 54(4), 1928: 249-250; 54(10): 562-563.

A blue book issued by Government of Siam gives a summary of the conditions of the teak forests of Siam and the history of the industry is reviewed.

3949 Bourke, D.R.S. 1927. **The teak industry of Siam**. Government Report, Royal Forest Department.

3950 Briggs, J.L. 1964. **Interim report of the revolutionary government of the Union of Burma on the teak industry (saw-milling and related operations)**. FAO/Expanded Technical Assistance Program Report 692: 41p.

Includes recommendations regarding old saw mills, new saw mills, industrial utilization of saw mill residues, auxiliary equipment, water transport, site of the old Bombay company saw mill at Dalleh and portable saw mills.

3951 Caslam; Dwiprabowow, H. 1994. **The analysis of direct selling performance of teak door products (case study: Teak wood processing industry in Cepu)**. (Indonesian). Jurnal Penelitian Hasil Hutan 12(4): 140-144.

3952 Djaban Tinambunan. 1978. **Manual cross-haul log loading in the teak industry**. Proceedings of the Eighth World Forestry Congress, Jakarta, 16-28 October 1978. Forestry for employment promotion FEP-13-4: 9p.

Results are presented from a study comparing the use of traditional methods of using poles, rope and crowbar and a hand winch system for loading logs onto lorries in central and E. Java.

3953 Gardner, J.R. 1943. **The teak industry of Burma**. Australian Timber Journal 8(2/3): p651, 653, 663, 665, 669, 694-695, 697-698, 714, 716.

3954 Hartono, W. 1979. **Magersaren, a forest village system in teak forest of Java**. Ergonomics in tropical agriculture and forestry: 134-135. PUDOC, Wageningen, Netherlands.

The magersaren forest village consists of twelve houses for forest workers built by the state, the workers are given training in forestry, agriculture and home industries and social facilities, such as education and health services, are provided.

3955 Khovanich, U. 1965. **Administration of teak section of forest industry organization**. (Thai). Vanasarn 23(1): 24-34.

3956 Kittisattho, S. 1993. **Demand for wood and marketing of wood products from wood factory, Changwat Chiang Mai**. Kasetsart University, Bangkok: 101 leaves.

There are only thirty five wood factories could run their business consistently because of raw material shortage and marketing problem of the products. The study found that about 14.29 percent are small wood factories which become to cease their business or to reduce the scale of production. Large wood factories of only about 25.71 percent.

3957 Maydell, H.J von. 1971. **Forest exploitation and forest industries in Ecuador. Forests and forestry in Ecuador**. Holz Zentralblatt 97(127/129): 1845-1846.

Briefly discusses problems of exploitation, plywood manufacture and future prospects in Part 1. Part 2 deals with forest types, species, etc., and development programmes, including projects for afforestation and trial plantings in coastal areas with *Tectona grandis* and other species.

3958 Mekvichai, B. 1988 . **The teak industry in north Thailand: The role of a natural resource based export economy in regional development**. Dissertation Abstracts International A, Humanities and Social Sciences 48(12): p3215.

The regional political economic and ecological effects are examined of over a century of a natural resource-based export economy, the teak industry of northern Thailand. Teak logging has altered the forest vegetative structure, causing changes in age structure and size of teak trees, higher regeneration of teak and higher density of vegetation, but with a reduction in number of species. Higher erosion rates and lower soil nutrient content, and higher runoff and lower water-retaining capacity were found in the soils of the more disturbed teak forest.

3959 Naing, U.K.K. 1997. **Wood based industries (teak) in Myanmar (a brief account)**. TEAKNET Newsletter 7: 6-7.

3960 Oluwalana, S.A. 1997. **An economic assessment of the existing teak and Gmelina plantations in Ogun State, Nigeria.** Nigerian Journal of Forestry 27(1/2): 40-47.

The economic assessment of the plantations shows that huge economic losses are sustained from the poor conversion of the woods in the sawmills. It is suggested that urgent steps are required to reduce wood waste in sawmills.

3961 Prahasto, H; Purnama, B.M. 1994. **Value-added of teak processing industry in Perum Perhutani Unit 1, Central Java**. (Indonesian). Jurnal Penelitian Hasil Hutan 12(1): 30-35.

3962 Radomiljac, A; Anderson, C; Sturre, T. 2003. **Development of a teak plantation industry in north Queensland, Australia**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Establishment success and the early growth provide evidence that plantation of teak has strong potential for commercial success in Australia.

3963 Suryasanoesiputra, H; Sastrodirahardjo, E. 1978. **Development pattern of integrated wood industries Perum Perhutani**. (English; Indonesia). Duta Rimba 4(26): 18-27.

A general account of the state owned forest industry in central and E. Java, which converts an increasing proportion of the teak logs produced by the state forest enterprise. Details are given of the various products and their output capacity at Central Java, which produces lumber, veneer, mouldings and parquet.

Go top

Wood Properties

(See also 2703, 4449, 4664)

3964 **Madagascar teak and Malabar mahogany**. Indian Forester 17, 1891: p447.

Madagascar teak is considered as a poor substitute for Malabar teak in London market.

3965 **Java teak**. Indian Forester 30(12), 1904: 542-543.

A note giving teak wood production figures in Java and export quantities with list of countries.

3966 **Indian teak supreme**. Indian Forester 52(8), 1926: p430.

Reports supremacy of Indian teak in U.K. and other countries for heavy work and forecasts great potentialities of export trade.

3967 **Teak in the Dehra Dun Division**. Indian Forester 52(9), 1926: 474-475.

From Lachiwala teak plantation of 50 years old 4.5-5 ft. girth at b.h. sample fellings revealed sound wood. Tests revealed Dehra Dun teak is slightly stronger than and not so stiff as most other trees of teak tested. Average strength values are above the common values for teak in general including Burma teak.

3968 **Burma teak**. Empire Exhibition, Glassgow, 1938: 28p.

Uses and properties of Burma teak are given.

3969 **Teak: Table of characters and properties of *Tectona grandis* Linn.f**. Holz 2(7/8), 1939: 319-320.

3970 **A craftsman must choose his wood**. Carp. Build. 135, 1946: p226.

Notes on the characteristics and uses of teak are given along with oak, ash, mahogany and birch.

3971 **Teak (*Tectona grandis*)**. Forest Research in India and Burma 1948-49 Part II, 1949: p36.

Based on thinnings in All India Teak Seed origin plots and statistical analysis of data, Nilambur and South Bombay origins are considered best conclusions of experiments with splitting teak stumps.

3972 **Teak (*Tectona grandis*)-colonial timbers**. Bios et Forests des Tropiques 15/16, 1950: 255-260; 361-368.

Teak is one of the species described.

3973 **We have been asked**. Bois et Forests des Tropiques 46, 1956: 48-54.

Dealt with many questions including use of teak thinnings as telegraph poles.

3974 **World timbers 15-18**. Suppls. to Wood 26(11/12), 1961: p27.

Dealt with teak along with many other timbers.

3975 **The properties of tropical woods. 20. Studies on the utilization of nine species from New Guinea and other areas**. (Japanese). Bulletin of the Government Forest Experiment Station, Meguro 269, 1974: 1-95.

Gives detailed descriptions of nine timbers which include teak.

3976 **Properties and uses of timbers from Papua - New Guinea and Fiji**. Timber and Wood Products Manual, Section 1H-4, 1977: 4p.

Information is tabulated giving trade and botanical name, colour, density, strength, shrinkage, durability and treatability and structural and general uses for 31 timbers which include teak from Papua New Guinea and 6 from Fiji.

3977 **Teak: Technical data sheet**. Bois et Forests des Tropiques 224, 1990: 39-47.

Wood properties and uses of teak are outlined. Its colour and grain, physical, mechanical and chemical properties, durability, seasoning, energy properties, sawmilling and uses particularly for boat building and furniture making are dealt with.

3978 Arkwright, P. 1961. **Know your timber 89-91**. Woodworking Industry 18(11/12): p659; 721.

Properties of teak are dealt with along with *Sequoia sempervirens* and *Dipterocarpus* spp.

3979 Berdug, A. 1946. **La teck d'Asie ou *Tectona grandis***. International du Bios 13(105): 72p.

Gives the properties and uses of wood.

3980 Bhat, K.M. 1999. **Is fast grown teak inferior in wood quality? - An appraisal: from plantations of high input management**. Wood News 9(1): 17-20.

The present paper discusses wood property differences to forecast the timber quality of teak grown under high input management. It is reported that phenotypically superior fast growing juvenile trees can produce larger diameter logs with greater yield of heartwood. Fast growing provenances/clones can be selected for teak management without reducing wood density. Faster growth in relatively young forest plantations with fertilizer applications/genetic inputs can be advantageous in terms of heartwood volume per tree and timber strength.

3981 Bhat, K.M. 2003. **Quality concerns of sustainable teak wood chain**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Whether teak maintains superiority in fast growing short rotation plantations is a major concern of the tree growers/investors, policy makers, traders and end-users of teak wood chain. While highlighting the teak wood quality demands of global market, promises from teak wood farming and home garden forestry, as sustainable options are discussed in this paper in the light of recent research findings.

3982 Bhat, K.M; Indira, E.P. 1997. **Effects of faster growth on timber quality of teak**. KFRI Research Report 132: 60p. Kerala Forest Research Institute, Peechi.

To enhance the productivity of teak plantations the choice of management techniques envisaged include genetic selection, wide planting spacement and/or thinning, pruning, fertilizer treatment, irrigation, etc.

3983 Bhat, K.M; Priya, P.B; Ancy Mathew. 2000. **Wood biomechanics of fast grown juvenile teak (*Tectona grandis* Linn.f.)**. Hannschristof Spatz and Thomas Speak, Plant Biomechanics: Proceedings of the 3rd Plant Biomechanics Conference, February - Badenweiler, August 2000: 397-402.

There was no significant difference in longitudinal compressive stress between juvenile and mature wood. The fast grown 5-year old trees from farm plantation had much lower bending stiffness although the values of specific gravity, MOR and MCS did not differ much from the standard teak values. It is the shorter and thinner walled fibres with wider microfibrillar angle that emerge as the main determining factors of the lower stiffness of juvenile wood.

3984 Bhat, K.V. 1991. **Teak - the superior timber**. Evergreen 26: p6.

Properties of teak timber are dealt with.

3985 Bianchi, A.T.J. 1936. **A comparative study of Java, Burmese and Siamese teak**. (Dutch; English). Tectona 29(11/12): 871-873.

3986 Blanford, H.R. 1922. **Teak as an even aged crop**. Indian Forester 48(8): 429-431.

Discusses ideal conditions for growth of best quality teak timber and recommends associating subsidiary species with teak in plantations like *Stephegyne diversifolia*, *Adina cordifolia* and *Lagerstroemia flosregniae* etc. which grow slower than teak, cover up soil and remain as understorey, keeping teak crowns free. Recommends wider initial espacement, along with introduction of subsidiary species.

3987 Blokhuis, G. 1919. **Determination table of the sort of trees which are in the teak wood in Java**. (Indonesian; English). Tectona 12: 539-550.

3988 Bonde. 1899. **Teak in Cochin China**. Empire Forestry Review 38: p534.

3989 Bourdillon, T.F. 1895. **The quality of quickly grown teak wood**. Indian Forester 21: 301-303.

Describes the properties of slow-grown and fast-grown teak timbers and concludes that both are suitable for different purposes.

3990 Brascamp, E.H.B. 1915. **Teak from Nigeria**. (Indonesian; English). Tectona 8: 383-384.

3991 Brascamp, E.H.B. 1915. **The Heidelberg grown teak**. Tectona 8: p712.

3992 Brascamp, E.H.B. 1917. **About teak wood of Java from 1746**. (Indonesian; English). Tectona 10: 421-433.

3993 Brascamp, E.H.B. 1921. **About teakwood in East Java in 1774, in Kolonial Archief No. XIX**. Tectona 14(8): 750-753.

3994 Brush, W.D. 1937. **Foreign woods: Teak**. United States Department of Agriculture, Forest Service, Washington, D.C: 11p.

The wood properties, principal uses, geographic distribution and site requirements of *Tectona grandis* are discussed. Commercial quantities in the natural forest are found only in India, Siam and Java.

3995 Brush, W.D. 1945. **Foreign woods: Teak (*Tectona grandis* Linn.f.)**. United States Forest Service, Washington: 13p.

A general account of teak is given which is a revision of an earlier publication.

3996 Cai-Zemo. 1994. **Wood properties of teak growing in Hainan Island**. (Chinese). Scientia Silvae Sinicae 30(6): 548-555.

3997 Caveye. 1905. **Note on strength of teak from various sources**. Bulletin of Social Forester, Belgium 12: p375.

3998 Chandrasekharan, C. 2003. **Qualities of teak and policy issues**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Teak is now grown in different scales by farmers, agriculturists, agro-foresters and investors of various types - individuals, share holding plantation companies and corporations. For reasonable economic return, teak is to be grown in comparatively good soil and requires good maintenance. The focus of this paper is on policy issues relating to the development of teak as a quality timber.

3999 Chowdhury, K.A. 1951. **West Bengal commercial timbers, their identification, prop-**

erties and uses. Indian Forest Records (n.s.) Wood Anatomy 1(3).

Teak along with 26 most important commercial timbers of West Bengal are dealt with. After some elementary notes on anatomical structure of woods, a dichotomous key for these timbers is given, followed by description of each timber with appendices on uses, main sources of supply and strength data etc.

4000 Chowdhury, K.A; Ghosh, S.S. 1958. **Indian woods-their identification, properties and uses - Vol. I**. Forest Research Institute, Dehra Dun.

Gives description of teak wood under the heads general properties, gross structure, strength, seasoning, natural durability, preservative treatment, working qualities, supply and uses.

4001 Chunwarin, W. 1992. **Properties and utilization of teak**. Proceedings of the Seminar on 50 Anniversary of Hyay-Tak Teak plantation, Bangkok, 5-8 August 1992.

Information on teakwood is reviewed. Structure and properties of teakwood are presented, along with discussions of some pertinent uses of teakwood.

4002 Clarke, S.H. 1938. **The properties of timbers as influenced by growth in tropical climates**. Empire Forestry Journal 17: 247-248.

By means of microstaining reactions, it was shown that the greater crushing strength of tropical woods, as compared to that of temperate zone woods is correlated with a higher degree of lignification in the former. Comparison of degree of lignification was done between unrelated species like ash and teak and also species of the same genus and even different trees of the same species growing under temperate and tropical conditions.

4003 Cordero, L.D.P; Kanninen, M. 2003. **Growth and timber quality of *Tectona grandis* in high input plantations of Costa Rica**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

The paper discusses aboveground biomass and the applicability on stand density management, wood quality of young and advance aged plantations, effects of stand density on wood quality, effects of stand density on growth and yield, preliminary pruning program, pruning intensity and timing, and total and merchantable volume equations.

4004 Corvanich, A. 1967. **Thai-teak**. Forestry Industry Organization: 8p. Ministry of Agriculture, Bangkok.

Discusses general properties of teak wood such as moisture content, ash, silica, specific gravity and weight. Discusses the distribution and requirements of teak with historical background of teak forests in Thailand. The largest teak tree of 930 cm in girth 40 m in height standing in Uttaradit province is illustrated. The management of teak forests was described and outlined the Forestry Industry Organization teak activities such as felling, transport, saw-milling and mechanisation in teak trade.

4005 Dahms, K.G. 1989. **Wood portrait: Teak**. (German). Holz als Roh-und Werkstoff 47(3): 81-85.

A general account of taxonomy, trade names, history of the teak trade, distribution, description of the tree, description of the timber, working properties, uses, substitute timbers and economic prospects is given. The main supplier of teak timber is Burma and only limited quantities are exported from Thailand and Indonesia.

4006 De, R.N. 1955. **Exotics of Assam (Teak)**. Indian Forester 81(7): 406-407.

Gives history of introduction of exotic species including *Tectona grandis* in Assam.

4007 Department of Forest Research, Nigeria. 1965. ***Tectona grandis* (teak)**. Forest Products Research Report, Department of Forest Research, Nigeria FPRL/3: 8p.

4008 Desch, H.E. 1947. **On the Mahoganies and teak woods, the teaks (*Tectona grandis*), Rhodesian teak (*Baikiaea plurijuga*), Philippine teak (*Dipterocarpus* sp.), Borneo teak (*Intsia* spp.) and African teak (*Chlorophora excelsa*) and Walnus etc**. Wood 12(11): 324-325.

Describes the teak and several other false teaks listed above.

4009 Dickinson, F.E. 1949. **Properties and uses of tropical woods-1**. Tropical woods 95: 1-45.

Teak is one of the species described and compared with well known American woods. Properties reported include - mechanical, non-mechanical, physical, seasoning, machining, steam bending, etc.

4010 FAO. 1948. **Report of the FAO mission for Siam**. FAO, Rome: 77.

A country report on teak is given. The growth of teak in Siam and comparative rates and qualities of Burma and Java teak are discussed.

4011 Ferguson, J.H.A. 1938. **Selection of stem quality**. (Dutch; English). Tectona 31: 729-740.

The author is of the opinion that form of stem and branching of the tree are constant and controlled genetically and are not affected by external factors such as site or climate, hence cannot be altered or improved by thinning systems. Bole quality can be improved by seed selection and suggests multiplication of mother tree vegetatively in seed gardens. Budding and grafting of teak is suggested.

4012 Forest Department, Burma. 1947. **Rules for girdling teak in Burma**. Chief Conservator, Forest Department, Burma Rules: 21p.

4013 Foulkes, F. 1914. **Teak in Wynaad: A study. Part I**. Indian Forester 40(5): 173-193.

The physiography and locality factors of Wyanad, Kerala are described, with an account of general and economic conditions effecting teak. The general characteristics and floristics of the growing stock are described. Teak forming 4-7 percentage of the natural crop. The distribution of teak as per stock maps and occurrence of mature teak trees are described.

4014 Freitas, M.C.P.G de. 1973. **Study of exotic timbers in Mozambique (I)**. (Portuguese). Rev. Cienc. Agronomicas 6: 3-28.

Gives details of the anatomical characteristics and physical and mechanical properties of the wood of four exotic species in Mozambique, viz. *Cedrela odorata, Melaleuca leucadendron, Tectona grandis* and *Juniperus sinensis*.

4015 Gamble, J.S. 1922. **A manual of Indian timbers**. Sampson Low Marston and Company Limited, London: 526-535.

A general description of tree, wood characteristics, extraction, regeneration methods, growth rates, physical and mechanical properties of different provenances, exports from Burma and other uses of teak like leaves as a dye and ash content of wood, insect pests and diseases are all generally discussed.

4016 Ghati. 1877. **Vitality of teak**. Indian Forester 3(1): 63-64.

4017 Gua, B.E. 1988. **Observations on timber samples of eighteen research and plantation species**. Forestry Division, Solomon Islands, Forest Research Note 53-21-88: 20p.

Observations are reported on the characteristics of wood samples of 18 species including teak from research trials and plantations in the Solomon Islands. Data regarding age, wood density, insect attack, sapstain, sawing properties, knots and heartwood and sapwood of the samples are provided.

4018 Hardjodarsono, M.S. 1984. **Teak (Indonesia)**. 79p. Gadjah Mada University Press, Yogyakarta.

4019 Haslett, A.N; Young, G.D; Britton, R.A.J. 1991. **Plantation grown tropical timbers. 2. Properties, processing and uses**. Journal of Tropical Forest Science 3(3): 229-237.

Wood properties, timber processing characteristics and potential timber uses of ten major tropical plantation species including teak have been evaluated at the Forest Research Institute, New Zealand. The differences between short-rotation plantation grown an longer rotation forest timbers, and the implications of these differences to the processor and user are highlighted. The major problems associated with plantation grown timbers are identified as reductions in density and decay resistance, lower timber recoveries due to growth stresses, smaller log size and a higher frequency of knots.

4020 Heekeren, M.A. 1917. **Teak wood in the Indian forestry**. (Dutch; English). Tijdschrift voor Economische-Geographi 4: 113-125. Agriculture University, Wageningen.

4021 Hilleanau. 1884. **Rubber v/s teak**. Indian Forester 10: 318-319.

Compares the economics and costs of raising rubber and teak plantations and recommends growing teak, as it is considered more profitable.

4022 Hinchiranant, S. 1963. **Verification comparing green and dry teak**. Vanasarn 21(2): 149-154.

Sixteen methods of verification of green and dry teak timbers are listed but they are not considered adequate and the author recommends to develop a more suitable method in the future.

4023 Hopens. 1907. **On teak**. Baifed Zur Tropenflan Zen 12: 378p.

4024 Howard, A.L. 1951. **A manual of the timbers of the world: Their characteristics and uses**. Macmillan & Company Limited, London.

The general characteristics of wood and its natural distribution are described. The properties of teak wood of its water contact resistance, rust prevention, durability etc. are described. The extraction methods including girdling before felling are described and cost of extraction by elephants is discussed. A general account of physical and mechanical properties and comparison of natural and plantation-grown teak is made.

4025 Immink, D.H. 1923. **Distribution of moisture in a green stem**. (Dutch; English). Tectona 16(7): 499-510, Korte Meded Proefsta Boschw 3: 1-13. Agricultural University, Wageningen.

The distribution of moisture in a transverse section through hardwood of teak is described and no correlation was found between this and width of annual rings in a disc. In view of sap movement against osmotic pressures the assumption that hardwood is not concerned with any physiological processes and observed moisture differences between adjoining zones.

4026 Jangal, M. 1877. **Vitality of teak**. Indian Forester 2(6): 313-314.

4027 Jutte, S.M. 1956. **Is yang teak real teak?** (Dutch; English). Houthandel 8: p356.

4028 Kakkar, S.S. 1970. **Insulating properties of some species of wood**. Indian Forester 96(1): 55-60.

Tectona grandis is one of the species for which the dielectric strength and dielectric constant has been measured along and across the grain.

4029 Karani, P.K. 1970. **On teak (*Tectona grandis*)**. Forest Department, Uganda, Technical Note 163.

4030 Keiding, H. 1973. **Case study, tropical hard woods-teak (*Tectona grandis* Linn.f.)**. Lecture notes FAO/DANIDA Training Course on Forest Tree Improvement, Limuru, Kenya, September-October 1973: 23p.

The need to exploit variation in the species by international provenance trials, progeny testing and clonal seed-orchard work, coupled with improvement programmes by vegetative propagation and controlled pollinations is described and the future action and breeding strategy to be adopted is discussed.

4031 Kirchof, F. 1961. **Investigations on teak**. (German). Holz Zentralblatt 87(10): 127-128.

Discussed the small-scale chemical and strength tests on samples from Java and Siam, its extractives, composition of the ash, tensile strength before and after extraction.

4032 Koegh, R.M. 2003. **The importance of quality of teak plantations**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

It is suggested that supplementary plantations are urgently required to produce renewable hardwoods for economic development, poverty alleviation and to decrease pressure on natural forests. Plantations that employ best management practices can be 20 times more efficient, in terms of production, compared to natural forests. Teak is the most widely cultivated quality hardwood species and has many advantages as a plantation grown species. New approaches taken to overcome the problems encountered in conventional plantations including the innovative consortium support system of TEAK 21 are discussed.

4033 Kulchararin, S. 1964. **Study on some characteristics of teak**. (Thai). Student Thesis. Kasetsart University, Bangkok.

A general and incomplete study on the subject.

4034 Lamb, G.N. 1948. **Foreign woods: Origin, use, properties and nomenclature**. Wood Products 53(7): 24p.

Teak is one of the species dealt with along with Chen-Chen and May-flower.

4035 Limaye, V.D. 1956. **Note on relative properties of teak from Burma and Indian regions**. FAO/TSC-56/27, National Progress Report on Teak: India: 21-27.

4036 Longwood, F.R. 1961. **Puerto Rican woods. Their machining, seasoning and related characteristics**. Agriculture Handbook, United States Department of Agriculture 205: 98p.

Discusses and tabulates results of tests including physical properties, warping, termite resistance etc., for the 56 most important native species plus 4 introduced species including teak with illustrated descriptions of each timber and notes on uses.

4037 Lushington, P.M. 1895. **The quality of quickly grown teak wood**. Indian Forester 21: 223-225.

Plantation grown teak is considered not inferior to natural grown teak timber.

4038 Mascarenhas, A.F; Kendurkar, S.V; Gupta, P.K; Khuspe, S.S; Agarwal, D.C. 1987. **Teak**. Cell and Tissue Culture in Forestry, Case Histories: Gymnosperms, Angiosperms and Palms Vol.3: 300-315: J.M. Bonga; D.J. Durzan, Eds. Martinus Nijhoff, Dordrecht.

4039 McDonald, A. 1946. **Teak aristocrat of the hardwoods**. Southern Lumberman 177(2225): 158-160.

Logging practices were discussed and the preference of teak is due to its hardness and durability. It has less coefficient of expansion, less corrosiveness in contact with iron, presence of essential oils making it durable and easy workability on machine or hand tools.

4040 Meniaud, J. 1930. **Properties of teak in tropical Africa**. National Bois College, Paris: 3p.

4041 Myint Kyu Pe. 2003. **Myanmar teak: Quality and exports**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Myanmar is a supplier of forest products, of which teak from natural forests play a major role. In order to ensure sustainable harvest, Myanmar selection system has been applied. Myanmar is committed to sustainable forest management and better market access, a timber certification committee has been established.

4042 Narayanamurti, D (et al). 1958. **Investigations on a specimen of old wood**. (German). Holz als Roh-und Werkstoff 16(7): 245-247.

The results of examining the structure, physical properties, and chemical composition of teak from a beam 1800 years old, from a Buddhist monastery in Kanheri are presented. The lumen was filled with a gum-like secretion and the extractive content was higher than in fresh teak. Density and compressive strength were higher and water absorption less.

4043 Narayanamurti, D; Purushotham, A. 1943. **Studies on permeability Part I, A preliminary note on the permeability of wood and other materials to air**. Indian Forest Bulletin 120 (n.s.) Utilization: 16p.

Measurement of permeability coefficients for several species of woods including teak, fibre-boards, plywood etc., was determined using an apparatus. The influence of various factors on permeability was discussed.

4044 Negi, S.S. 1996. **Teak (*Tectona grandis*)**. Bishen Singh, Mahendra Pal Singh, Dehra Dun, India: 1-3.

4045 Nisbet, J. 1907. **The chief timber trees of India**. Indian Forester 33(1): 41-48.

The importance and value of teak tree is discussed and teak forests of India are described, including seed germination, fire and exploitation problems.

4046 Nopsuwan, P. 1961. **Form quotient of teak at different site in Huay-Tak teak forest, Ngao, Lampang Province**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Studied the form quotient for teak of different site classes and found that site quality is different to sites in form quotient and there is no significant difference between certain sites.

4047 Okuyama, T; Yamamoto, H; Wahyudi, I; Hadi, Y.S; Bhat, K.M. 2003. **Some crucial wood quality issues of planted teak**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

In the context of promoting timber production in fast growing teak plantations, a study is made to show the variability in the

growth and the relationships between growth rate and selected wood properties, including growth stress in plantations of Indonesia and India. Results show that growth acceleration by silvicultural treatment such as fertilization does not always adversely affect the wood qualities in teak.

4048 Oteng-Amoako, A.A; Gyima-Boadi, N; Apetorgbar, M. 2000. **The properties of the intermediate wood in teak**. Forest Products Research Institute, Ghana. Technical Report.

4049 Polato, R; Laming, P.B; Sierra-Alvarez, R. 2003. **Assessment of some wood characteristics of teak from Brazilian origin**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Chemical composition, fibre length distribution, mechanical and physical properties and natural durability are determined to assess the quality of Brazilian wood. Basic density is also determined. It is assumed that Brazilian teak does not differ from the high quality Asiatic teak and it will be suitable for the same range of end uses.

4050 Quint, M.P.L. 1956. **Service report: Teak in Dahomey**. FAO Teak Sub-Commission, Bangkok FAO/TSC-56/21: 4p. FAO, Rome.

4051 Ramakrishnan, V. 2003. **Why are we obsessed with teak**. Wood News 13(1): 8-13.

4052 Record, S.J; Hess, R.W. 1943. **Timbers of the New World**. Yale University Press, New Haven: 640p.

The timbers are grouped in families and families and the genera are arranged alphabetically. Each family is prefaced by a general account of its chief botanical features, its economic importance and distribution and a summary of its wood characters. Each genus is described in detail with special reference to the most important species including teak.

4053 Richter, H.G; Leithoff, H; Sonntag, U. 2003. **Characterisation and extension of juvenile wood in plantation grown teak (*Tectona grandis* Linn.f.) from Ghana**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

For qualitative and quantitative characterisation of juvenile wood, heartwood of eighteen teak trees from five plantations in Ghana was studied with regard to the radial variations in growth ring width, vessel diameter, microfibril angle, natural durability, density, sorption behaviour, compression and bending strength and modulus of elasticity. The results are compared with those obtained from four 81 to 314 year old trees from natural stands in Myanmar. Significant differences between teakwood from plantations and natural stands were detected.

4054 Sandermann, W; Dietrichs, H.H. 1958. **Accessory substances contributing to the properties of woods**. Results of Paper chromatography in Chemical Abstract 52, 6792b.

The extracts of teak woods from Rangoon, Siam, and Java gave tectoquinone in decreasing amounts in the order given, in line with known termite resistance of these woods.

4055 Sandermann, W; Schlumbom, F. 1962. **The effect of filtered ultra-violet light on wood. I. Photometric and chromatographic investigations on wood**. Holz als Roh-und Werkstoff 20: 245-252.

Wood meals from 10 species including teak were irradiated with light. The effect of such radiation is expressed in terms of a change in absorption coefficient. This change increases with decreasing wavelength of the radiation. The effect for wood thoroughly extracted is roughly independent of the species. The effect for original wood is markedly dependent on species.

4056 Sandermann, W; Simatupang, M.H (et al). 1963. **Investigations on woods containing rubber**. (German; English). Holzforschung 17(6): 161-168.

Out of the wood from 150 selected tree species investigated, eight species including teak revealed the presence of rubber in the xylem. In teak and other three species the rubber content was more than one percent. Rubber was confined to the parenchyma tissue of the xylem and tended to be restricted to the heartwood.

4057 Sanwo, S.K. 1983. **Variation in wood characteristics of plantation grown teak (*Tectona grandis* Linn.f.) in Nigeria**. Ph.D Thesis. University Wales, Bangalore.

4058 Savard, J; Andre, A.M; Caumartin, L. 1963. **The action of wood on iron**. (French; English; Spanish). Bois et Forests des Tropiques 91: 41-52.

Describes a rapid method of classifying species as regards their corrosive effects on iron. No action on iron was observed in teak. The method described takes account both of the amount of Fe-ions absorbed by the wood, and the amount of Fe combined with certain extractives which precipitate in the presence of the metalion.

4059 Schwab, E. 1992. **Rate of moisture uptake in wood**. Holz als Roh-und Werkstoff 50(7/8): p312.

4060 Seaman, I.N. 1930. **Plantation grown teak**. Indian Forester 56(10): 421-425.

The relative strength of plantation and natural grown teak is discussed and found that the plantation grown teak is as strong as forest grown material.

4061 Sekhar, A.C. 1966. **A method of evaluation of wood quality on the basis of utilization characters**. Indian Forester 92(4): 269-274.

An index based on adjusted and weighted data for dimensional stability, durability, strength, fissile qualities, wearing qualities, working qualities and appearance is proposed and discussed methods of determining these.

4062 Slade, H. 1895. **Notes on girdling of teak in Tharrawaddy**. Indian Forester 21(3): 104-111.

Notes on locality factors and forests of Tharrawaddy Division are given, along with season and rules of girdling, the methods and problems are described.

4063 Sreefuree, T.S. 1965. **Synthetic teak**. Vanasarn 23(3): 182-184.

The author describes the problem of mixing non-teak and false teak woods in export teak trade, thus lowering quality of teak and its reputation.

4064 Street, E.C.F. 1914. **Substitutes for teak**. Indian Forester 40(7): 381-382.

Reporting the properties of teak like non-corrosive and greasy properties making it durable.

4065 Suvarnasudhi, K. 1950. **Some commercial timbers of Thailand**. Royal Forest Department, Bangkok: 51p.

4066 Suvarnasudhi, K. 1954 . **Some commercial timbers of Thailand: Their properties and uses**. II Edition, Udom Press, Bangkok, Thailand.

The author presents some general information concerning useful timbers of Thailand which contains about thirty two species along with teak.

4067 Temu, A.B; Malende, Y.H. 1988. **Quality assessment of *Tectona grandis* growing at Mtibwa, Tanzania**. Journal of the Tanzania Association of Foresters 6: 11-21.

Visual estimates were made of stem straightness, roundness and decay in teak planted as part of the Mtibwa forest Project. It is suggested that selective thinning would yield a high quality final crop. It is suggested that wounds inflicted during preparation of the planting stock and during the first tending served as entrances for decay fungi.

4068 Timber Development Association, London. 1941. **Teak (*Tectona grandis*)**. Timber Development Association, London: 9p.

This mimeographed pamphlet gives the names, teak substitutes, distribution, characteristics, wood properties and qualities, along with principal uses and sizes of teak timbers ordinarily available in market.

4069 Tint, S; Kyi, W; Kwye, T. 1995. **Properties of teak**. Proceedings of the Teak Symposium Myanmar Japan Technical Co-operation Programme: 4-10.

4070 Topp, T. 1957. **Teak wood and creamery churns of teak**. Maelkeritidende 70(26): 535-537.

4071 Trotter, H. 1941. **The common commercial timbers of India and their uses**. Manager of Publications, Delhi: 234p.

The manual consists of information of timbers and the timbers are listed in groups under the particular uses for which they are suitable. Appended the comparative strength properties of the timbers in percentage of those of teak and an index to botanical and common names.

4072 Troup, R.S. 1932. **Exotic trees from the British Empire**. Clarendon Press, Oxford: 225-227.

Introduction of teak in Queensland, Kenya, Malaya, Nigeria, Nyassaland, Trinidad and Tobago etc., are discussed.

4073 Wagenfuhr, R. 1969. **Wood properties table 12: Teak**. (German). Holztechnologie 10(3): 203-204.

4074 Weaver, P.L. 1993. ***Tectona grandis* Linn.f. teak**. United States Department of Agriculture, Forest Service, SOITF-SM-64: 18p.

4075 Wolff von Wulfing, H.E. 1928. ***Tectona grandis* Linn.f**. Tectona 21: 879-886.

Go top

Wood Structure and Properties

(See also 0667)

4076 **Structure of imported woods (Nos. 26-30)**. (Japanese). Bulletin of Forestry Experiment Station, Meguro, Tokyo 150, 1963: 123-132.

Notes on the anatomy, with low-magnification photomicrographs of transverse, radial and tangential sections of teak are given along with other trees.

4077 Abbate, M.L.E. 1977. **Anatomical, physical and working properties of twenty two woody species from Thailand**. (Italian). Contributi Scientifico Pratici per una Migliore Conoscenza ed Utilizzazione del Legno 21(54): 75p.

The woods of twenty two species from Thailand are briefly described and illustrated with photomicrographs. Comparative tables giving data on the anatomical and physical characteristics of the woods are included.

4078 Akachuka, A.E; Abolarin, D.A.O. 1989. **Variations in pith eccentricity and ring width in teak (*Tectona grandis* Linn.f.)**. Trees: Structure and Function 3(2): 111-116.

Values of percentage of pith eccentricity of stem cross-sections were computed using appropriate geometrical methods and the growth rings of the cross-sections were identified and their widths measured. Pith eccentricity and ring width varied along trees and tree stems. On average, pith eccentricity was highest at the base and top of the merchantable stem. A decrease in ring width corresponded with an increase in the age of the vascular cambium.

4079 Arce, V.H. 2001. **Sapwood heartwood relationships and wood physical characteristics of 10 year old teak from two different plantation densities in Playa Garza, Cuanacasts**. Bachelor Thesis: 36p. Universidad Nacional, Heredia, Costa Rica.

4080 Bailleres, H; Durand, P.Y. 2000. **Non-destructive techniques for wood quality assessment of plantation grown teak**. Bois et Forests des Tropiques 263: 17-29.

Examined whether wood quality is similar when it comes from natural forests and plantations. Need for assessing wood quality of plantation-grown teak led CIRAD-Foret to develop its own methodology and non-destructive assessment techniques on standing trees, which are presented.

4081 Bhat, K.M. 1995. **A note on heartwood proportion and wood density of 8-year-old teak**. Indian Forester 121(6): 514-517.

Wood properties, viz. ring width, basic density and heartwood percentage, were studied at breast height in trees sampled from plantation in Nilambur, Kerala. Faster growth was associated with a higher heartwood percentage while wood density was independent of growth rate.

4082 Bhat, K.M. 1998. **Properties of fast-grown teak wood: Impact on end-user's requirements**. Journal of Tropical Forest Products 4(1): 1-10.

This paper examines selected wood properties of fast-grown teak to assess the impact on end-user's requirements. The juvenile wood is not so weak as to affect the solid wood uses of fast-grown timber from plantations of shorter rotations. Fast-grown wood displays lower microfibrillar angle as well as greater dimensional stability and structural performance.

4083 Bhat, K.M. 1999. **Is fast grown teak inferior in wood quality - an appraisal of wood figure (colour, grain, texture) from plantations of high input management**. Wood News 9(3): 48-49.

The paper discusses wood figures of colour, grain, texture differences and forecasts the timber quality of teak grown under high input management.

4084 Bhat, K.M. 1999. **Is fast grown teak inferior in wood quality? - an appraisal: From plantations of low input management**. Wood News 8(4): 27-31.

The present paper appraises teak wood quality, in terms of heartwood proportion and timber strength, from plantations of relatively low input management in India. Fast growing dominant superior trees yielded higher heartwood percentage per tree during the juvenile period up to 21 years. It is reported that teak has the potential to produce timber of optimum strength in relatively short rotations of 21 years in suitable plantation sites.

4085 Bhat, K.M. 1999. **Properties and utilisation of small timber resource of teak plantations**. The Proceedings of National Seminar on Processing and Utilisation of Plantation Timbers and Bamboo, IPIRTI, Bangalore, 23-24 July 1998: 255-261. K. Damodaran; B.S. Aswathanarayana; T.R.N. Prasad; K. Shyamasundar; S. Padmanabhan, Eds. Indian Plywood Industries Research and Training Institute, Bangalore.

The paper discusses selected wood properties of 13 and 21 year old trees to assess the utilization potential of small timber available from teak thinnings and short rotation plantations in Kerala. It is not so inferior as to be rejected for the manufacture of high value products such as veneer, joinery, furniture, etc. But it requires improved processing technology and revision of grading rules and quality standards for teak plantations and intensive management techniques to enhance the log size and quality and reduce the negative effects of juvenile wood.

4086 Bhat, K.M. 2000. **Investigations into heartwood formation in intensively managed teak plantations**. KFRI Research Report 181: 13p. Kerala Forest Research Institute, Peechi.

A study is made to generate information to see whether fast growth will help in quicker formation of heartwood and whether intensive management practices and site conditions influence the yield of heartwood in short rotation plantations. The preliminary results indicated that heartwood formation begins at the age of even before three years in fast grown trees of managed plantations.

4087 Bhat, K.M. 2000. **Is fast grown teak inferior in wood quality? - an appraisal of durability of juvenile wood**. Wood News 10(1): 37-39.

Appraised the natural durability of 5-year-old juvenile teak grown in a farm plantation in Kerala. The results indicate that the juvenile wood grown in intensively managed plantations is not necessarily inferior in natural durability to that grown in traditional forest plantations. It is comparable in natural durability to the inner heartwood of mature teak.

4088 Bhat, K.M . 2000. **Timber quality of teak from managed tropical plantations with special reference to Indian plantations**. Bois et Forests des Tropiques 263: 6-16.

Fast growing dominant trees found to yield a higher percentage of heartwood per tree during the juvenile period of 21 years. Teak produce timber of optimum strength with relatively short rotations of 21 years at suitable plantation sites.

4089 Bhat, K.M; Bhat, K.V; Dhamodaran, T.K. 1985. **Wood and bark properties of branches of selected tree species growing in Kerala**. KFRI Research Report 29: 34p. Kerala Forest Research Institute, Peechi.

Data are reported on wood and bark density, percentage of bark and heartwood, proportions of anatomical components like fibres, vessels, rays, parenchyma, and fibre length in stems and branches of teak along with ten other species.

4090 Bhat, K.M; Bhat, K.V; Dhamodaran, T.K. 1986. **Thickness and percentage of bark in some timbers grown in Kerala**. Journal of the Indian Academy of Wood Science 17(1): 23-29.

Data are given for nine species including teak.

4091 Bhat, K.M; Bhat, K.V; Dhamodaran, T.K. 1989. **Radial patterns of density variation in eleven tropical Indian hardwoods**. Holzforschung 43(1): 45-48.

Samples from different stump height were analysed for density in teak along with other hardwoods. The radial pattern of density variation differed between species and within species between trees at similar height and within single trees between heights.

4092 Bhat, K.M; Bhat, K.V; Dhamodaran, T.K. 1989. **Fibre length variation in stem and branches of eleven tropical hardwoods**. IAWA Bulletin 10(1): 63-70.

Fibre length variation of stem and branches of eleven tropical hardwoods including teak is studied. It is found that the branch fibres are significantly shorter than stem fibres. In branches, fibre length increased more or less linearly from the pith to the bark, which indicates juvenile growth.

4093 Bhat, K.M; Priya, P.B; Rugmini, P. 2001. **Characterisation of juvenile wood in teak**. Wood Science and Technology 34(6): 517-532.

Properties of juvenile wood were studied of teak from three 63-year-old plantations in Kerala to assess the utilization potential of short rotation timber. Juvenile wood is characterized by wide rings, short fibres, small vessel diameter, low vessel percentage, high percentage cell wall, wide microfibrillar angle and relatively low or almost similar mechanical properties.

4094 Bhat, K.M; Thulasidas, P.K; Easa, P.S. 1989. **Bark fibre length of some Indian tropical trees**. Indian Forester 115(11): 839-841.

Data are reported on the minimum, mean and maximum bark fibre length of thirty Indian timbers including teak from forests in Kerala. Bark fibre length is found generally greater than wood fibre length.

4095 Bhattacharya, J; Chakravarty, K.N. 1976. **On some features of sawdust characters in wood identification**. Journal of the Indian Academy of Forensic Science 15(2): 17-19.

Sawdust of *Tectona grandis* and other tree species was macerated in a mixture of 1g K chlorate and 50 ml concentrated nitric acid, then warmed in a water bath at 50-60 deg C for 1-2 min, rinsed in water, stained with safranin, mounted in glycerol and examined under the light microscope for wood identification.

4096 Brennan, G.K; Radomiljac, A.M. 1998. **Preliminary observations on the utilisation and wood properties of plantation teak (*Tectona grandis*) and African mahogany (*Khaya senegalensis*) grown near Kununurra, Western Australia**. Australian Forestry 61(2): 120-126.

The wood properties and wood quality were assessed of teak grown in irrigated plantations in northern Western Australia. Basic wood properties as well as recoveries, sawing and drying behaviour and working properties were assessed. The plantation teak was golden brown in colour with dark markings.

4097 Carreras, R; Dechamps, R; Avella, T. 1989. **Three-dimensional structure of the wood of five species of Verbenaceae represented in Cuba**. (Spanish). Revista Forestal Baracoa 19(2): 67-84.

Details are given of scanning electron microscopic studies on the anatomical structure of the wood of *Tectona grandis* along with other species.

4098 Chowdhury, K.A. 1939. **The formation of growth rings in Indian trees Part I (a) Chir, (b) Cutch, (c) Jaman, (d) Laurel, (e) Sal, (f) Semul, (g) teak**. Indian Forest Records (n.s.) Utilization 2: 39p.

Growth rings are distinct and annual in teak. Foliar development always preceded diameter growth in the main trunk. In teak activity spreads rapidly downwards and cambial activity has been observed simultaneously in twigs and trunk. The effect of temperature, rainfall and humidity is also discussed.

4099 Chowdhury, K.A. 1940. **The formation of growth rings in Indian trees. Part III. A study of the effect of locality**. Indian Forest Records (n.s.) Utilization 2: 59-75.

Investigations were carried out on the growth activity and dormancy of teak in relation to local climatic conditions. There is a possibility that leaf-fall may be regulated by an internal water balance of the tree. The ring porous wood of teak shows some structural variations in the pore zone according to the locality in which it is grown.

4100 Chowdhury, K.A. 1943. **How to identify timbers. Part III. Timbers for motor lorry bodies**. Indian Forest Leaflet (Utilization) 37: 17-29.

This gives brief anatomical descriptions and a key for the field identification of important Indian timbers including teak used for motor-lorry bodies.

4101 Chowdhury, K.A; Preston, R.D; White, R.K. 1967. **Structural changes in some ancient Indian timbers**. Proceedings of Royal Society of London 168B(1011): 148-157.

Specimen timbers of 2200 years old *Tectona grandis* were examined and compared with wood of the same species along with many other species. It was held in a frequently damp, humid atmosphere for 2200 years is superficially sound, the wood is in part degenerated, the cellulose content, including the crystalline component was considerably reduced.

4102 Clarke, W. 1946. **Photography by infrared; its principles and applications**. John Wiley and Sons, Newyork: 472p. Chapman & Hall Limited, London.

Gives transparency to infra-red rays for teak and other timbers.

4103 Cordero, L.D.P; Kanninen, M. 2003. **Heartwood, sapwood and bark content and wood dry density of young and mature teak (*Tec-***

***tona grandis*) trees grown in Costa Rica**. Silva Fennica 37(1): 45-54.

4104 Coster, C. 1926. **Abnormal structure in stems of *Tectona grandis***. Annales du Jardin Botanique de Buitenzorg: p120.

4105 Das, D.K. 1984. **Wood anatomy of some timbers of Verbenaceae of Bangladesh**. Forest Research Institute Chittagong, Bulletin, Wood Anatomy Series 6: 28p.

Gross features and microscopic anatomy of the wood are described for nine species which include teak. An anatomical key for identification and brief data on distribution in Bangladesh are included.

4106 Dave, Y.S; Rao, K.S. 1982. **Plastid ultrastructure in the cambium of teak (*Tectona grandis* Linn.f.)**. Annals of Botany 49(3): 425-427.

4107 Donaldson, L.A. 1984. **Wood anatomy of five exotic hardwoods grown in Western Samoa**. New Zealand Journal of Forestry Science 14(3): 305-318.

4108 Fernandes, A; Wisnu, J; Hartoyo, A.T; Rulianti, E; Marsoem, S.N; Lukmandaru, G. 2002. **Fiber dimensions of tension wood and opposite wood of teakwood (*Tectona grandis*)**. IAWA Journal 23(4): p462 .

4109 Gogate, M.G. 1995. **Evaluation of growth response of teak to high inputs**. Indian Forester 121(6): 578-580.

Data are reported on the wood properties of sample billets from thinnings from a 7-yr-old irrigated and fertilized plantation in W. Maharashtra. The properties of the thinnings from the irrigated fertilized plantation were found inferior to the standard one and the suitability indices are found 31-80.

4110 Gottwald, H; Parameswaran, N. 1980. **Anatomy of wood and bark of Tectona (Verbenaceae) in relation to taxonomy**. Botanische Jahrbucher fur Systematik, Pflanzengeschichte und Pflanzengeographie 101(3): 363-384.

Wood and bark samples of *T. grandis* were studied under the light microscope and SEM. X-ray microanalysis was used to locate silica and calcium phosphate within the tissues. Both were detected in the vessel lumina of *T. grandis*.

4111 Gupta, R.S. 1950. **A note on the practical application of the recommendations made in the Indian Forest Bulletin No. 141, regarding the forecasting of the quality of teak from the soil and site characteristics**. Indian Forester 76(5): 210-214.

The field laboratory methods are given for determining ratio of SiO_2 to sesquioxides, dispersion coefficient and depth of permanent moisture availability together with a list of necessary apparatus and chemicals.

4112 Hamza, K.F.S; Ringo, W.N. 1991. **Variation of heartwood proportion in plantation grown *Tectona grandis* Linn.f**. Faculty of Forestry, Sokoine University of Agriculture, Record 51. Morogoro, Tanzania.

The age at which heartwood starts to form and the relation between various stem parameters and heartwood proportion in *Tectona grandis* were studied in plantations in Tanzania. Determined the heartwood proportion and its variation with age, diameter at breast height, total tree height and height in the stem. It was found that heartwood starts to form when the trees are between 7 to 9 years old.

4113 Hillis, W.E. 1968. **Heartwood formation and its influence on utilization**. Wood Science and Technology 2(4): 260-267.

The chemistry and biochemistry of teak wood is provided.

4114 Isenberg, I.H. 1952. **Fiber measurements of tropical wood fibers**. Tappi 35(4): 145-147.

Gives dimensions of fibres and vessel segments for twelve species of tropical American hardwoods and Burma teak.

4115 Jane, F.W. 1956. **The structure of wood**. Adam and Charles Black Limited, London: 427p.

The names and classification of timbers with a classified list of more important plant genera that produce wood of economic importance, the histology of wood, the trunk of the living tree, the gross structure of wood, the histology of deciduous woods, etc. are provided. A key for the identification of wood and specific differences in timbers, with an appendix on technique for wood anatomy is also provided.

4116 Johnston, D.R. 1951. ***Pseudotsuga taxifolia, Mimusops havhalli, Pterocarpus dalbergloides, Tectona grandis* structure drawing to specimen woods-Sheet 2**. Wood 16(8): p304.

A general series of structural drawings relating to gross features with descriptions of woods, in which teak is also included.

4117 Kadambi, K. 1956. **On the nature of twisted fibre and the occurrence of interlocked fibre in some trees**. Proceedings of the 8th Silvicultural Conference, Dehra Dun, 1951, Part 2: 227-228.

Species are listed in which spiral grain, interlocked grain, or both, have been found. The list include teak also. Interlocking grain improves bending and shear strength.

4118 Kawcharoen, K. 1962. **Percentage of barkwood of teak at Mae-Huat Forest, Lampang**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Analysed twenty teak trees in diameter classes 35-55 cm and height classes 25-30 m and 34-35 m.

4119 Kedharnath, S; Chacko, V.J; Gupta, S.K; Mathews, J.D. 1963. **Geographic and individual tree variation in some wood characters of teak (*Tectona grandis* Linn. f.). I. Fibre length**. Silvae Genetica 12(6): 181-187.

Variations in fibre length were measured of trees of four seed origins of Nilambur, N. Bombay, N. Burma and S. Burma. It is found that fibres in the ring nearest the pith were very short, but their length increased rapidly in the next few rings and thereafter slowly. Differences varied according to provenances.

4120 Kokutse, A.D; Bailleres, H; Stokes, A; Kokou, K. 2004. **Proportion and quality of heartwood in Togolese teak (*Tectona grandis* Linn.f.)**. Forest Ecology and Management 189(1/3): 37-48.

The heartwood proportion, modulus of elasticity and wood density of trees of various ages from different ecological zones in Togo were examined to determine the ecological zone which produce the best quality teak wood.

4121 Lawton, J.R. 1971. **Seasonal variations in the secondary phloem of some forest trees for Nigeria**. New Phytologia 70(1): 187-196.

Samples of bark were taken from the main trunk of trees including teak and found the amount of active phloem and the total depth of the fluorescent zone. The greatest amount of active phloem coincided with the rainy season.

4122 Mathew, L; Shah, G.L. 1983. **Vestured pits and warts in Verbenaceae**. IAWA Bulletin 4(1): 39-40.

Of the twenty three species studied warts were observed on the inner surface of vessels in *Citharexylum* and *Tectona grandis*.

4123 Menon, P.K.B. 1947. **Growth rings of locally-grown teak**. Malaysian Forester 11(1): 26-27.

Teak poles analysed had diamond-shaped piths with elongated comers. The larger poles had dark-coloured heartwood of irregular shape. The growth rings varied in width. They were fairly distinct although not so clear as in teak grown in regions with definite seasons. The rings were usually caused by regions of denser fibres, strands of bright-coloured parenchyma and larger-sized vessels.

4124 Moya, R. 2002. **Effect of cambium age, growth rate and precipitation on the basic density of teak in Costa Rica**. (Spanish). Madera y Bosques 8(1): 39-49.

A study is made to determine the change in specific gravity in the radial direction, from the pith to the bark, as well as the influence of cambium age, growth rate and precipitation in trees growing at the Caribbean side of the Costa Rica. Results showed that specific gravity increases from pith to bark and that it is affected by cambium age and growth rate.

4125 Nair, M.N.B; Chavan, R.R. 1985. **Dimensional analysis of some wood parameters in eleven timber trees**. Indian Forester 111(6): 410-417.

Relationships of trunk length, girth, cross-sectional areas of wood, heartwood and sapwood, heartwood/sapwood ratio and percentage of heartwood in the cross-section were studied for eleven timber species including *Tectona grandis* and the results are presented.

4126 Narayanamurti, D; Prasad, B.N. 1959. **Examination of Indian woods by x-rays**. Holz als Roh-und Werkstoff 17: 223-226.

X-ray diffraction was used to determine micellar orientation and it was found in teak. It has irregular orientation.

4127 Nobuchi, T; Boonplian, S. 1992. **Some characteristics of teak (*Tectona grandis* Linn.f.) wood in relation to wood quality**. IAWA Bulletin 13(3): p260.

Samples were analysed for seasonal characteristics of wood formation and heartwood formation.

4128 Parameswaran, N. 1964. **The length of septate fibres in *Tectona grandis***. (German). Report from Naturwissenschaften 51(13): 317-318.

Fibre length in both septate and non-septate fibres in two successive growth rings of a stem with ring-porous wood increased from the early to the late wood. Septate fibres were shorter than non septate fibres and their increase in length in the late wood was less. Mean fibre length increased significantly from pith to bark.

4129 Priya, P.B; Bhat, K.M. 1997. **Wood anatomical changes in juvenile teak due to insect defoliation**. IAWA Journal 18(3): 311-317.

Selected anatomical characteristics and wood specific gravity of 8-year-old teak trees growing in Nilambur protected from insect defoliation were compared with those from an unprotected population. During the protection period of four years trees showed a considerable increase in growth rate relative to unprotected trees.

4130 Pumijumnong, N; Eckstein, D; Sass, U. 1995. **Tree-ring research on *Tectona grandis* in Northern Thailand**. IAWA Journal 16(4): 385-392.

The first principle component of the data showed 44 percent of the total variation in the tree-ring data, indicating a considerable climate influence on tree growth. The climate/growth relationship suggested that growth of the teak in the study area is mainly controlled by rainfall from April to June.

4131 Purkayastha, S.K; Rao, K.R. 1969. **Studies on the relationship between structure and specific gravity in teak**. Recent Advances in the Anatomy of Seed Plants. Choudhury, K.A., Ed: 127-35. Hindustan Publishing Corporation, Delhi.

4132 Purkayastha, S.K; Tandon, R.D; Rao, K.R. 1972. **Variation in anatomical structure of teak and its influence on specific gravity and maximum crushing stress**. Indian Forester 98(6): 332-337.

Studies on samples of teak in India showed that fibre-wall thickness was significantly correlated with the specific gravity of the wood, and that this relation was influenced to some extent by the proportion of fibres in the wood. There was also a highly significant correlation between fibre-wall thickness and maximum crushing stress.

4133 Rao, C.J.M; Reghu, C.P; Patel, J.D. 1982. **Rays in reaction wood of three angiosperm species**. Indian Journal of Forestry 5(3): 216-222.

Vertical branches and inclined branches of identical girth and inclination were selected from trees including *Tectona grandis* from the University Botanical Garden at V.V. Nagar. The lower tiltwood of *T. grandis* had more rays than the higher tiltwood. Rays contiguous to vessels were taller than those contiguous to fibres and axial parenchyma.

4134 Rao, K.R; Purkayastha, S.K; Tandon, R.D. 1966. **Effect of rate of growth on proportion of tissues in teak**. Indian Forester 92(2): 133-136.

Preliminary studies of the proportion of tissue elements in several consecutive growth rings, using Ladell's method in two samples of *Tectona grandis* from Mysore and Kerala showed no definite relationship between ring width and the proportion of tissues, but differed in their tissue elements.

4135 Rao, K.S. 1988. **Cambial activity and developmental changes in ray initials of some tropical trees**. German Democratic Republic Flora 181(5/6): 425-434.

Structure, divisional activity and dimensional variations of ray initials in *Tectona grandis*, *Gmelina arborea* and *Mangifera indica* were studied in relation to the annual cycle of cambial activity.

4136 Rao, K.S; Dave, Y.S. 1983. **Ultrastructure of active and dormant cambial cells in teak (*Tectona grandis* Linn.f.)**. New Phytologist 93(3): 447-456.

4137 Sanwo, S.K. 1987. **The characteristics of the crown-formed and stem-formed wood in plantation grown teak (*Tectona grandis* Linn.f.) in Nigeria**. Journal of the Institute of Wood Science 11(2): 85-88.

Samples were taken from different locations within the crown formed wood ie. between the first and seventh ring from the pith and stem formed wood ie., rings eight outwards from Ibadan. The samples were assessed for ring width, relative density, MOR, MOE, total work done and maximum compressive strength parallel to the grain. The crown formed wood had statistically higher values for ring width, relative density and maximum compressive strength than the stem-formed wood.

4138 Srisakdi, P. 1962. **Stem analysis of teak**. (Thai). Student Thesis. Kasetsart University, Bangkok.

On the basis of data of twenty teak trees in dbh class 30-68 cm and heights 2.4 to 34.8 m, it was found out rate of growth in height, volume and dbh for age classes 10, 20, 30, 40 and 80 on upto 130 years.

4139 Starte, H.W. 1923. **Peculiarity noticed in the annual rings of teak Kolaba Division, Bombay**. Indian Forester 49(7): 392-393.

Growth rings on teak towards later part of life of tree are so close and dense as undistinguishable, except, outer 2 or 3 rings. Outer sapwood appeared as a mass of spongy tissue.

4140 Sukwong, S. 1971. **Estimating the age for trees without annual rings**. (Thai). Faculty of Forestry, Kasetsart University, Thailand, Research Note 5: 4 p.

A method for determining the age of trees by calculations based on the growth percent, was checked against one plot of teak of known age in a plantation at Lampang. Results showed the calculated age to be close to the actual age.

4141 Sutopo, S. 1992. **The enhancement of utilization quality of young teak wood for furniture crafting in Surakarta**. Duta Rimba 18(147/148): 2-6 (In), 7-10 (En).

An investigation was made of the utilization of teak thinnings for furniture making in Surakarta Forest District, Java. The traditional finishing processes are described and finishing problems of blistering, bubbling, cracking etc. caused by use of wood with too much moisture content noted.

4142 Tativa, G.E; Sadhardjo; Corryanti. 2002. **Wood anatomy of teak**. The Fifth Pacific Regional Wood Anatomy Conference. Abstracts from the Meeting of the IAWA Pacific Regional Group and IUFRO S 5.01 (Wood Quality), Yogyakarta, Indonesia, 9-14 September 2002. IAWA Journal 23(4): P480.

4143 Varghese, M; Nicodemus, A; Ramteke, P.K; Anbazhagi, G; Bennet, S.S.R; Subramanian, K. 2000. **Variation in growth and wood traits among nine populations of teak in Peninsular India**. Silvae Genetica 49(4/5): 201-205.

Growth, wood characteristics and bark thickness were studied in relation to climatic, edaphic and latitudinal factors in 60-year-old plantations and natural populations of teak. The very moist population of Nilambur, Kerala is found to have the best growth and form but comparatively lower wood density on par with the slightly moist natural stand and the dry teak population of Maharashtra. Sapwood content was negatively correlated with growth rate. Properties of bark thickness and wood density are also investigated.

4144 Venugopal, N; Krishnamurthy, K.V. 1987. **Seasonal production of secondary phloem in the twigs of certain tropical timber trees**. Annals of Botany 60(1): 61-67.

Results of a study based on samples from four deciduous trees including teak and three evergreen trees in Tamil Nadu are presented. There was one flush of phloem production in *Tectona grandis* and the evergreen species and there were two flushes in the other deciduous species.

4145 Venugopal, N; Krishnamurthy, K.V. 1987. **Seasonal production of secondary xylem in the twigs of certain tropical trees**. IAWA Bulletin 8(1): 31-40.

Results of the study based on samples of four deciduous species including teak and three evergreen species from Tamil Nadu are presented. The phenology and secondary xylem production of each species are briefly described. In the evergreen species and *Tectona grandis*, there was only one annual period of xylem production.

4146 Venugopal, N; Krishnamurthy, K.V. 1989. **Organisation of vascular cambium during different seasons in some tropical timber trees**. Nordic Journal of Botany 8(6): 631-638.

The vascular cambium of *Tectona grandis* was non-storied. Ray initials were multiseriate. The radial walls of cambial cells were beaded. The fusiform initials were less vacuolated during dormancy.

4147 Wang, S.Y. 1988. **The properties and identification of S.E. Asian woods (X)**. (Chinese). Forest Products Industries 7(2): 79-90.

Descriptions of teak are given along with other species.

Go top

Go top

Physical and Mechanical Properties

(See also 0860, 4316)

4148 **Strength of plantation and natural grown teak in South India**. Indian Forester 38(3), 1912: 126-128.

Results of compression tests, shearing tests and transverse strength of natural and plantation timber are tabulated. The tests show plantation teak is slightly stronger than natural teak plantation.

4149 **Colonial timbers**. (French). Bois For. Trop 15-6, 1950: 251-260.

Dealt with teak along with other timbers.

4150 **Physical and physico chemical investigations**. Forest Research in India Part I: 1951-52, 1952: p66.

The influence of psychrometric conditions on the properties of six species including *Tectona grandis* was investigated. Generally the strength values were higher for the laminated material than for the solid wood. The strength in bending and compression decreased with increase in moisture content.

4151 **Quality of locally-grown teak**. Malaysian Forester 17(1), 1954: 29-30 .

Notes on physical and mechanical properties of wood from one 30 year old tree grown in Johore. They compared favourably with those for teak from Burma and Malabar.

4152 **Dielectric properties of some Indian species**. Forest Research India and Burma 1950-51 Part 1, 1955: 73p.

Preliminary experiments were made on the dielectric breakdown strength of various species including teak.

4153 **Gluing teak**. (Norwegian). Extract from Arsberetn Norsk Tretekn. Inst 21, 1963: p37.

The efficiency of the following glues have been studied and found that furfuryl modified urea glue, an acid phenolic glue, and a 1:3 mixture of PVA and urea glues gave excellent results. Ordinary urea and PVA glues gave good results with pressures and resorcinol. Cleaning the surface with non-polar solvents before applying urea, or sanding the surface before gluing with PVA or casein glues, appeared to improve results.

4154 Ashiabor, W.K. 1968. **The properties of *Afzelia africana, Anogeissus liocarpus, Cynometra ananta, Guibourtia ehie* and *Tectona grandis***. Forest Product Research Institute, Ghana, Technical Note 6: 7p.

The results of strength tests on these species, carried out at the Forest Products Research institute, Ghana are tabulated. Brief notes are given on species distribution, wood characteristics and utilization.

4155 Aswathanarayana, B.S; Victor, V.J. 1973. **Stress relaxation in wood**. Journal of the Indian Academy of Wood Science 4(1): 1-12.

Some theoretical aspects of stress relaxation are considered from the molecular point of view, and stress-relaxation tests in compression parallel on samples of *Tectona grandis* are described. The effects of initial stress value and moisture content on stress decay were investigated.

4156 Bali, B.I; Gupta, V.K. 1980. **A note on the physical and mechanical properties of *Shorea talura* from eastern Kanara division, Karnataka**. Journal of the Timber Development Association of India 26(2): 8-10.

Physical and mechanical properties are tabulated for green and air-dried *Tectona grandis* along with *Shorea talura*.

4157 Bali, B.I; Guru, R.D; Negi, Y.S. 1987. **A note on the physical and mechanical properties of *Bischofia javanica* (uriam) from Banderdeva Division, Arunachal Pradesh**. Indian Forester 113(4): 287-294.

Comparative data are tabulated for standard teak from Nilambur, Malabar and Coimbatore.

4158 Bali, B.I; Singh, K.R. 1981. **A note on the physical and mechanical properties of *Aphanamixis polystachya* (*Amoora rohituka*) from Kalimpong division, West Bengal**. Journal of the Timber Development Association of India 27(2): 30-35.

Comparative data of standard teak is given.

4159 Bali, B.I; Singh, K.R. 1983. **A note on the physical and mechanical properties of *Tectona grandis* (teak) from Gorakhpur Division, Uttar Pradesh**. Journal of the Timber Development Association of India 29(1): 25-34.

Physical and mechanical properties in green and air dry conditions based upon tests conducted on small clear specimens obtained from three logs of *Tectona grandis* from Gorakhpur Division, Uttar Pradesh have been reported. Suitability indices and safe working stresses have been reported and compared with the corresponding value of standard teak. Calculated values based on strength - specific gravity relationship have also been reported for comparison purpose.

4160 Batey, T.E; Wangaard, F.F. 1949. **Moisture absorption in certain tropical American woods**. Yale School of Forestry, Technical Report 1: 7p.

The results of tests of water absorption of twenty five tropical American species including teak are given and the timbers are classified according to overall absorption of moisture into the heartwood and the side grain absorption of moisture into the middle portion of the heartwood of endcoated specimens.

4161 Berger, L.G den. 1926. **Mechanical properties of Dutch East Indian timbers**. Korte Meded Proefsta Boschw 12: 63p.

Results of bending tests, end-wise compression, shearing cleaving and hardness tests for teak and other species are tabulated. The specific gravity of wood, mechanical properties of green and air dry woods and growth rings are given.

4162 Betancur Salgado, C.A; Herrera, B.J.F; Mejia Mesa, L.C. 2000. **Study of the physical and mechanical properties, workability and drying of teak (*Tectona grandis* Linn.f.) in Puerto Libertador (Cordoba)**. (Spanish). Revista Facultad Nacional de Agronomia Medellin 53(1): 913-939.

The Caribbean Reforest Company established a teak plantation in the region of Puerto Libertador, Colombia. Data were collected on specific gravity, shrinkage and humidity content, static bending, compression parallel and perpendicular to grain, shear parallel to grain, hardness, nail resistance and toughness. The workability test was carried out in air dried conditions, observing the reactions of wood to brushing, moulding and drilling.

4163 Bhat, K.M. 1995. **Properties and quality of teak timber with special reference to juvenile wood**. Amazon Teak Foundation, Consultancy Report: 46-50; Raadhuisstraat, The Netherlandas: 1-39.

4164 Bhat, K.M; Bhat, K.V; Dhamodaran, T.K. 1987. **A note on specific gravity difference between dominant and suppressed trees in teak (*Tectona grandis* Linn.f.)**. Indian Journal of Forestry 10(1): 61-62.

Relative density was estimated for samples taken from two dominant and two suppressed trees from a plantation at Nilambur, Kerala.

4165 Bhat, K.M; Bhat, K.V; Dhamodaran, T.K. 1990. **Bark specific gravity in stem and branches of nine Indian timbers grown in Kerala**. Indian Journal of Forestry 13(1): 26-29.

Data are reported for nine species including teak. Bark specific gravity was reported higher than that of wood in six species including teak. Correlations between wood and bark specific gravity were significant for most species.

4166 Bhat, K.M; Bhat, K.V; Dhamodaran, T.K. 1990. **Wood specific gravity in stem and branches of eleven timbers from Kerala**. Indian Forester 116(7): 541-546.

Basic specific gravity was determined for blocks cut from stems and branches of eleven species from Kerala. Data are tabulated on average specific gravities at base, middle and top of stems and branches, and average of overall specific gravity of stems and branches. Seven timbers including teak were classed as moderately heavy.

4167 Bhatnagar, N.S. 1964. **Creep of wood in tension parallel to grain**. (German). Holz als Roh-und Werkstoff 22(8): 296-299.

Short and long term creep tests on teak showed that creep deformation was a linear function of stress up to a certain limiting stress and a non-linear one above it.

4168 Bianchi, A.T.J. 1937. **The mechanical properties of Java, Siam and Burmese teak**. (Dutch; English). Tectona 30(5/6): 33-49. Nederland-Sch--Indie 60.

Strength data is presented on static bending, impact bending, compression parallel to grain, shear, cleavability and special grade of material and results presented for different samples from different countries. Java material lies between Burma and Siam in its mechanical properties.

4169 Biblis, E.J. 1965. **Shear deflection of wood beams**. Forest Products Journal 15(11): 492-498.

The paper shows the relative contribution of shear deflection to the total deflection of rectangular wood beams of several species including *Tectona grandis*. It demonstrates how the amount of shear deflection is affected by the ratio of pure modulus of elasticity to modulus of rigidity of the species and by the span-to-depth ratio of the beam.

4170 Boye, C. 1965. **A study of some electric moisture meters for wood**. (Danish). Troeindustrien 15(11): 139-146.

Gives tabulated results of a study comparing measurements made with seven moisture meters on different species including teak.

4171 Bryce, J.M. 1966. **Mechanical properties of Tanzania-grown teak (*Tectona grandis* Linn.f.)**. Utilization Section, Forest Division, Moshi, Technical Note 34: 5p.

Tests made on plantation grown teak from near Korogwe showed that it was 15 percent weaker in properties than specimens from Burma and Trinidad. There was a positive correlation between strength and specific gravity, and a negative correlation between density and rate of growth.

4172 Burmester, A. 1972. **Swelling and swelling anisotropy of wood in various moisture content ranges**. (German). Holz als Roh-und Werkstoff 30(10): 380-381.

The relative swelling in the tangential and radial directions is expressed in percent of the maximum swelling. It was found that about half the total swelling takes place between 86 and 100 percent of relative humidities.

4173 Burmester, A. 1975. **Dimensional stabilization of wood**. (German). Holz als Roh-und Werkstoff 33(9): 333-335.

The good dimensional stability of *Tectona grandis* is attributed to its low content of hydrolysable hemicelluloses. By heat/pressure treatment of moist wood similar effects are obtained. On filling the void spaces in the wood structure or on cross-linking between molecules, dimensional stability of wood can be improved.

4174 Burmester, A; Wille, W.E. 1975. **Investigations on the dimensional stability of teak**. Holz als Roh-und Werkstoff 33(4): 147-150.

Physical and chemical investigations were made on material from a freshly felled teak tree and from a tree that had been left standing for two years after girdling the sapwood. It is suggested that the low content of hydrolysable hemicelluloses in teak is an important factor in its dimensional stability.

4175 Castro, F; Raigosa, J. 2000. **Growth and physical mechanical properties of seventeen years old teak (*Tectona grandis*) growing in San Joaquin, Abangares, Costa Rica**. (Spanish). Agronomia Costarricense 24(2): 7-23 [Revista Forestal Centroamericana 35, 2001: 19-24].

The physical and mechanical properties of seventeen year old teak trees growing in San Joaquin, Costa Rica were evaluated according to the ASTM standard. Results of the physical and mechanical properties studied indicate that teak timber from Costa Rica have good dimensional stability.

4176 Coster, C. 1923. **Moisture content and regional spread of moisture in living teak**. (Indonesian; English). Tectona 16(11/12): 935-1045.

Regional spread of moisture in a tree from base to top are examined. Moisture content is expressed as percentage of cell cavity filled with free water as moisture content depends on the special grade of wood.

4177 Coster, C; Immink, D.H. 1930. **Research of the same physical properties of teak wood and both sorts of Mahogany**. Meded Boschbouw Proefsta 18.

4178 Deshkar, A.M; Dara, S.D. 1988. **Sorption of mercury by *Tectona grandis* bark**. Asian Environment 10(4): 3-11.

4179 Dharmcharee, B. 1957. **The active principle in *Tectona grandis***. (Siamese; English). Vanasarn 15(2): 23-31.

Reviews previous work and gives results of the physical and chemical experiments on samples of teak from various parts of Siam. Analysis of the ether extractive yielded o-cresyl-methyl-ether, with the characteristic odour of teak wood, which the author considers is the active preservative principle. Results of some further investigations of this compound are discussed.

4180 Ding, J.Y. 1979. **Studies on dimensional stabilization of woods (1) The stabilization of woods by treatment of stearamidomethylpyridinium chloride**. (Chinese). Experimental Forest, National Taiwan University, Technical Bulletin, 124: 75-102.

This reagent was shown to be more satisfactory than PEG in the treatment of six high-density species including teak.

4181 Doungpet, M. 2003. **Physical and mechanical properties of juvenile teak wood (*Tectona grandis*)**. IUFRO Division 5 conference, Rotorua, 11-15 March 2003.

4182 Durand, P.Y. 1983. **Wood technology research in the Ivory Coast. Towards a rational utilization of secondary species of the natural forest and technological control of quality and quantity of plantation-grown timber**. Bois et Forests des Tropiques 202: 35-52.

The density and shrinkage was assessed of twenty nine secondary species. Some species of potential industrial value could be selected from the initial results. Wood technology studies were made of the plantation species *Tectona grandis* and *Gmelina arborea*.

4183 El Osta, M.L.M; Badran, O.A; Ajoung, E.M.A. 1981. **Crushing strength of three Sudanese tropical hardwoods in relation to specific gravity, extractives and lignin contents**. Wood Science 13(4): 225-232.

Three Sudanese tropical hardwoods studied are *Tectona grandis*, *Khaya grandifoliola* and *Isoberlinia doka*.

4184 Eligon, A; Saunders, R; Kai, A.T; Hutchison, J.D. 1984. **Studies on hysteresis properties in Trinidadian timber**. Proceedings of the Pacific timber engineering conference, Auckland, New Zealand, May 1984. Volume III. Wood science: 840-848. Institution of Professional Engineers, Wellington, New Zealand.

Expansion and contraction properties were studied in six commercially important species including teak exposed to a series of increasing and decreasing Rh environments.

4185 Forest and Forest Products Research Institute, Japan. 1978. **Properties of some Papua New Guinea woods relating with manufacturing processes. VIII. Lumber processing of some West New Britain woods**. (Japanese). Forest and Forest Products Research Institute, Japan, Bulletin 299: 105-149.

Sawing studies on twenty three species including teak showed that heavier woods required more power from the saw. Optimum schedules are presented for kiln seasoning of these species. Cutting properties, gluing properties, curing time and cracking of varnish films, bending strength and nail-holding properties are tabulated.

4186 Forest and Forest Products Research Institute, Japan. 1978. **Properties of some Papua New Guinea woods relating with manufacturing processes. VI. Wood qualities, physical properties and decay durability of some West New Britain woods**. (Japanese). Forest and Forest Products Research Institute, Japan, Bulletin 299: 23-84.

Structure, physical and mechanical properties and resistance to fungal decay were investigated in twenty three species. Log dimensions, interlocked grain, brittle-heart, moisture content, relative density, shrinkage, static and impact bending strength, weight loss caused by decay, and retention of preservatives are tabulated for each species.

4187 Fujita, S; Takahashi, A; Sakurai, T. 1967. **On the drying properties of tropical woods**. (Japanese). Bulletin Faculty of Forestry, Shimane University, Japan 1: 83-86.

Examined the relationship between kiln-drying time and seasoning defects in *Tectona grandis* along with other species and tabulates the drying time required for a reduction in moisture content from 60 percent to 10 percent.

4188 Ganther, W.D; Cole, I.S; Bhamornsut, C; Chotimongkol, L; Purwadaria, S; Hue, N.V. 2000. **A survey of moisture content of timbers in open and sheltered exposures across South East Asia**. Proceedings of 26th Forest Products Research Conference: Research developments and industrial applications and Wood Waste Forum, Victoria, Australia, 19-21 June 2000: 98-99. L. Schimleck; P. Blakemore, Eds. CSIRO Forestry and Forest Products, Clayton, Australia.

4189 Ginoga, B; Kamil, R.N. 1973. **Notes on the physical and mechanical properties of teak wood (*Tectona grandis* Linn.f.) from Sumbawa**. Laporan, Lembaga Penelitian Hasil Hutan 2: 2p.

4190 Gnanaharan, R; Ghosh, S.K; Balasundaran, M; Dhamodaran, T.K. 1984. **Predictors of ultimate strength of mistletoe-infested teak (*Tectona grandis* Linn.f.)**. Holzforschung 38(5): 293-295.

Static bending tests were carried out on mistletoe infested teak wood. Highly significant correlations were obtained between

MOR and MOE, MOR and fibre stress at proportional limit and MOR and density relationships. The strength of mistletoe-infested teak can be predicted in machine stress grading either by MOE or by FSPL.

4191 Higgins, N.C. 1957. **The equilibrium moisture content/relative-humidity relationships of selected native and foreign woods**. Forest Products Journal 7(10): 371-377.

The equilibrium moisture content - relative humidity relationships was studied for a number of commercially important woods including *Tectona grandis*. Data were presented on volumetric shrinkages, fibre saturation points, specific gravity and hysteresis loops for *Tectona grandis* along with other species both natural and when impregnated with phenolic resin.

4192 Hiromu, K; Mukudai, J. 1971. **Wetability of wood. VII. Heat of wetting of wood in water (2)**. (Japanese). Hyoto Furitsu Daigaku Gakujitsu Hokoku, Nogaku 23: 100-104.

Heat of wetting varied with wood species, wood constituents and composition and type of wood. Heat of wetting of woods rich in extracts was relatively low. Heat of wetting of sapwood slightly exceeded that of heartwood.

4193 Hojendahl, K. 1946. **Measurements of dielectric constant and dielectric loss of different wood species: Investigation of the dependency on direction, water content, frequency and temperature**. K. VetHojsk. Aarsskr 1-32.

Variation in dielectric constant with temperature was investigated for several species particularly teak.

4194 Hojendahl, K. 1948. **Measurements with Schering's bridge of dielectric constant and dielectric loss of different wood species**. Aarsskr. Vet.- Landbohojsk: 29-41.

Schering bridges were used to measure dielectric constant and loss of teak, in axial and radial directions. The dielectric constant increases with temperature and water content, but varies little with frequency.

4195 Immink, D.H. 1930. **Investigations into the physical properties of teak wood etc**. (Dutch; English). Meded Proefsta Boschw 18: 1-97.

The investigations on physical properties of teak and mahogany from experiments of Immink are compiled by Coster especially shrinkage of girdled and green teak.

4196 Imperial Forestry Institute. 1914. **Mechanical properties of teak from Nigeria**. Imperial Forestry Institute Bulletin 12: p360.

4197 Indira, E.P; Bhat, K.M. 1997. **Variability and heritability of wood density in teak (*Tectona grandis* Linn.f.)**. Journal of Tropical Forestry 13(1): 1-5.

Wood density variation was studied in teak clones and in provenances grown in Kerala. Analysis of the data showed that phenotypic coefficient was low for both clones and provenances and genotypic coefficient variation was negligible. The heritability on individual tree basis was low for clones while it was zero for provenances. Major part of the variation is due to tree-to-tree variation rather than provenances and hence selection of individual trees will help the improvement programme.

4198 Indira, E.P; Bhat, K.M. 1998. **Effects of site and place of origin on wood density of teak (*Tectona grandis*) clones**. Journal of Tropical Forest Science 10(4): 537-541.

The effects of site and clone origin on basic wood density of teak were studied in eighteen clones vegetatively propagated from plus trees and grown at two seed orchards in Kerala. It is showed that site had a highly significant influence on wood density, while place of origin of clones was less significant. No evidence of any interaction between site and clones could be detected.

4199 Jain, N.C; Dev, I. 1969. **Machining qualities of some Indian timbers**. Holzforschung und Holzverwertung 21(1): 12-18.

Out of the machining properties of timbers studied, it is found that teak has good machining propertis.

4200 Jain, V.K. 1992. **Stress-strain behaviour of teak (*Tectona grandis*) under repeated loading in compression**. Indian Forester 118(2): 142-147.

The elastic-plastic properties of air dried boards of *T. grandis* were studied under repeated loading-deloading cycles of compression parallel to grain. The results demonstrated the presence of the plastic part of strain even at low applied loads. Within the elastic limit, the wood starts to behave as elastic with repeated loading-deloading cycles.

4201 Jain, V.K; Arora, K.L; Sharma, A.K. 1993. **A note on the movement of some Indian timbers**. Indian Forester 119(11): 936-939.

Movement is the term applied to shrinkage and swelling of seasoned wood in service, due to fluctuations in atmospheric conditions. Movement is determined for six Indian species including teak between 32 and 93 percent relative humidity. Teak is found to have the least movement.

4202 Jain, V.K; Sanyal, S.N; Dangwal, M.N. 1988. **Irreversible stress-strain behaviour of some Indian timbers**. Journal of the Indian Academy of Wood Science 19(1): 63-70.

The stress-strain behaviour of wood is compared with that of ideal elastic materials using data from successive tests of tension strength and compressive strength parallel to the grain on specimens of eight species including teak. The test data of strain during loading and unloading for each type of strength test are presented, together with stress-strain curves drawn for *Tectona grandis* and *Cedrus deodara*.

4203 Kadita, H; Mukadai, J. 1971. **Studies on the wetability of wood. The heat of wetting of wood in water**. (Japanese). Scientific Reports of the Kyoto Prefectural University Agriculture 23: 100-104.

The total heat of wetting of the wood of thirty different softwoods, temperate hardwood and tropical hardwood species, and of major wood components were measured at 30 deg C. It is found that the total heat of wetting for water ranged from 12.65 to 18.60 cal/g of dry wood, was greater for sapwood than heartwood, was about the same for early and late wood, and was a little below average for woods of high extractive content e.g. *Dalbergia latifolia* and *Tectona grandis*.

4204 Kakkar, S.S. 1969. **Frequency dependence of dynamic elastic constant of wood**. Indian Forester 95(6): 418-424.

The dynamic elastic constant of wood parallel to the grain was determined for species including *Tectona grandis* by a sensitive flexural vibration technique. The calculated radiation constant was 40 percent higher for teak than for the other three species tested.

4205 Kelley, T.M. 1956. **U.S. Navy experience with carbides applied to woodworking machines**. Forest Products Journal 6(4): 159-161.

Among the instances of successful use cited is the machining of 150,000 linear feet of teak for decking without regrinding, as against 200 with high-speed steel.

4206 Kennedy, R.W. 1958. **Strength retention in wood decayed to small weight losses**. Forest Products Journal 8(10): 308-314.

A study of twelve species varying widely in origin, density and durability, were tested after controlled decay by *Polyporus versicolor* and *Poria monticola*. Strength loss, as measured by the modulus of rupture in static bending and work to maximum load, was less for *Polyporus versicolor* than for *Poria monticola*. Teak lost 27 percent in work to maximum load when the weight loss was 1 percent.

4207 Keylwerth, R; Christoph, N. 1960. **The study of thermal decomposition of wood by differential thermal analysis**. Materialprufung, Dusseldorf 2(8): 281-288.

Describes exploratory experiments, in which heat reactions and heat production of a test substance are investigated by comparing its thermogram with the differential temperature curve of an inert substance under identical conditions of gradual controlled heating. Thermograms of teak is presented along with other species.

4208 Koppel, C van de. 1948. **Is there a timber that can replace teak as decking for ships in the tropics**. (Dutch). Ber. Trop. Prod. Ind. Inst. Amst. 219: 9p (Schip en Werf 15(5), 1948: 78) .

Results of an enquiry made among a number of shipbuilders and shipping companies are discussed.

4209 Lim, S.C; Gan, K.S. 1998. **Density variation of Malaysian-grown teak**. Journal of Tropical Forest Products 4(2): 141-145.

The density of Malaysian-grown teak was found comparable to that of teak found elsewhere. Age had a significant effect on the density of the timber.

4210 Limaye, V.D. 1933. **Third interim report on project No.1 - physical and mechanical properties of woods grown in India**. Indian Forest Records (n.s.) Utilization 18(10).

4211 Limaye, V.D. 1935. **On growth rate and strength of teak**. Indian Forest Records (Economy series) 18: 10p.

4212 Limaye, V.D. 1939. **The comparative strengths of some important Indian timbers and their uses**. Indian Forest Records (n.s.) Utilization 1.A: 28p.

Teak and 35 other timbers were dealt in this paper.

4213 Limaye, V.D. 1942. **Interim report on the relation between rate of growth and strength of natural and plantation teak**. Indian Forest Bulletin (n.s.) Utilization 113: 13p.

It is reported that there is a significant correlation between the rate of growth and strength of teak. Rate of growth of about 5 to 6 rings per inch has been found to produce the strongest wood while a growth rate greater than about four rings per inch produces very weak timber. Plantation grown teak is found equal to natural teak as far as strength is concerned, although it is slightly lighter in weight and faster grown.

4214 Limaye, V.D. 1942. **Interim report on the rate of growth and strength of natural and plantation teak**. Indian Forester 68(7).

From the analysis of data on the rate of growth and strength of natural and plantation grown teak it is found that the rate of growth of about 5 to 6 rings per inch produce the strongest timber and a rate of growth faster than about 4 rings per inch produces very weak timber.

4215 Limaye, V.D. 1942. **Note on Indian timbers for aircraft and gliders**. Indian Forest Records (n.s.) Utilization 2: 168-177.

Brief notes on species suitable for aircraft construction and its distribution, availability and strength properties are provided. Teak will be used with synthetic resin glues.

4216 Limaye, V.D. 1944. **Suitability and selection of timbers for different uses. Parts I and II**. Indian Forest Records (n.s.) Utilization 3(5): 34p.

This bulletin provides comparable data on the properties of a number of timbers, as a guide in selecting the most suitable for different uses. Index figures and stick graphs are given to show the value of each timber in relation to teak with reference to weight, strength as a beam, suitability as a post, shock-resisting ability, retention of shape, shear and hardness.

4217 Limaye, V.D. 1953. **Standard terminology for describing timbers**. Indian Forester 79(2): 77-86 .

Taking teak as the standard, the physical and mechanical properties of some 100 Indian timbers are compared with it by index figures. The species considered are classified according to their weight, strength as beams, hardness, impact resistance and stability.

4218 Limaye, V.D. 1956. **Weights and specific gravities of Indian woods**. Indian Forest Records (n.s.) Timber Mechanics 1(4): 107p.

Presents tables of average weights and their maximum and minimum observed values for 300 consignments of wood species including teak. Approximate average weights of green logs of freshly felled trees are also calculated.

4219 Limaye, V.D; Seaman, L.N. 1933. **The physical and mechanical properties of woods grown in India**. Indian Forest Records (Economic Series) 18(10).

4220 Lin, J.L; Wang, S.Y. 1986. **Studies on the use of microwave irradiation to improve plasticity of wood. I. The effects of microwave irradiation on the moisture content and temperature of wood**. Forest Products Industries 5(2): 29-39.

Thirteen species were tested including teak to know the effect of irradiation on moisture content and temperature. After irradiation, moisture content was 1.3 times higher on the surface than in the inner parts of the wood; this would be beneficial for bending.

4221 Machacheep, Y. 1966. **Comparison of the hardness of teak timber from plantation of various ages in Lampang Province**. (Thai). Student Thesis. Kasetsart University, Bangkok.

A correlation was observed between hardness and age of plantation grown teak.

4222 Mang, W. 1958. **The blunting of rotary cutters in forward and counter motion**. (German). Mitt. dtsch. Ges. Holzforsch 40: 809p.

Results of the studies of the effect of glue-lines on blunting in the machining, testing the effect of types of glue, and age and thickness of glue-lines under various conditions of feed, cutter speed, cutting angle, tool materials etc. are presented. Preliminary tests on the effect of these variables were made on solid beech and teak and the merits of various criteria and methods for measuring wear are discussed.

4223 Moya, R; Cordero, L.D.P; Arce, V.H. 2003. **Wood density of *Tectona grandis* at two plantation spacing in Costa Rica**. Journal of Tropical Forest Products 9(1/2): 153-161.

A cross-sectional disc at diameter breast height was collected and found that wood basic density tended to increase with increasing age of cambium. Wood basic density was found to be higher at 6 x 2 m spacing than at 3 x 3 m spacing.

4224 Muchjacheep, Y. 1966. **Comparison of hardness of teak timber from plantations of various ages in Lampang province**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The age and hardness of teak is correlated and also age and density of teak wood. In 22 years hardness is high and at 5 years old it is low.

4225 Mukdasanit, B. 1959. **Study on correction factors used with capacity type electrical moisture metre for teak**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Gives the method and details of correlation factors working for the apparatus used.

4226 Mukherji, H.K; Bhattacharya, P.K. 1963. **A study of the correlation between different pairs of physical and mechanical properties of teak (*Tectona grandis*) grown in various localities of India and Burma**. Indian Forester 89(3): 207-217.

A high positive correlation was found between specific gravity and maximum crushing strength for both natural and plantation grown teak. Specific gravity could be used as an indicator of maximum crushing strength in certain localities, with a fairly high degree of precision.

4227 Nair, K.R; Mukherji, H.K. 1957. **A statistical study of the variability of physical and mechanical properties of *Tectona grandis* (teak) grown at different localities of India and Burma and the effects of the variability on the choice of the sampling plan**. Indian Forest Records (n.s.) Statistical 1(1): 49p.

Significant differences were found to exist in all the six properties tested, specific gravity, rings/inch, maximum crushing strength in compression parallel, modulus of rupture, modulus of elasticity and impact bending. It is indicated that no significant differences exist between specific gravity and rings/inch in general.

4228 Nair, K.R; Mukherji, H.K. 1960. **Classification of natural and plantation teak (*Tectona grandis*) grown at different localities of India and Burma with regard to its physical and mechanical properties**. FAO/TSC 60/4.13-4.14: 1-2.

The paper discusses the results of multi-variate analysis of data on important strength properties namely specific gravity, modulus of rupture, modulus of elasticity, and maximum crushing stress for samples of natural and plantation teak in the Indian Burma region tested at Forest Research Institute.

4229 Nair, K.R; Mukherji, H.K. 1960. **Classification of natural and plantation teak (*Tectona grandis* Linn.f.) grown at different localities of India and Burma with respect to its physical and mechanical properties**. Sankhya 22(1/2): 1-20.

Discusses the results of a multivariate analysis of data on strength properties such as specific gravity, modulus of rupture, modulus of elasticity and maximum crushing stress of teak from natural forests and plantation forests.

4230 Narayanamurti, D. 1960. **Movement of moisture in wood caused by a temperature gradient**. Norsk Skogind 16(12): 577-579.

Tabulated the results of experiments in Indian species including teak of density range, the rate of diffusion of moisture in cylinders of wood having a difference in temperature between the two halves.

4231 Narayanamurti, D; Bhargavarama, K.L. 1968. **The swelling and shrinkage of wood under mechanical restraint - some further experiments**. Drev-arsky Vyskum 2: 77-86.

Air-dry specimens of five Indian hardwoods including *Tectona grandis* placed in clamps were soaked and then oven-dried and repeated 10 times. The successive dimensional changes under tangential and radial restraint and for uncompressed controls are shown and also the course of swelling recovery on soaking the treated blocks. The cycling treatment increased density and compressive strength.

4232 Narayanamurti, D; Verma, G.M. 1972. **Swelling and shrinkage of wood under mechanical restraint. Influence of various factors on *Tectona grandis***. Holzforschung und Holzverwertung 24(4): 83-93.

Oven dry blocks taken from different positions in a tree of *Tectona grandis*, unextracted or extracted with water or organic solvents, were clamped tangentially or radially, and then soaked in water. Cycles of drying and wetting under restraint were repeated until no further shrinkage occurred. The rate of recovery and extent of setting at the end of the cycle were determined and found that the reduction in size was smaller for *T. grandis*.

4233 Narayanamurti, D; Zoolagud, S.S; Rangaraju, T.S. 1970. **Swelling and shrinkage of wood under mechanical restraint - influence of temperature**. Drev-arsky Vyskum 2: 43-50.

Oven-dried heartwood specimens of ten Indian hardwoods including *Tectona grandis* were subjected to a clamping/soaking/drying/measurement cycle. Soaking was done by keeping the test pieces in boiling water for five hours. Tabulated data from strength tests made after swelling recovery show that the cycling treatment improved compression strength.

4234 Negi, G.S; Bhatia, D.N. 1958. **Physical and mechanical properties of woods tested at F.R.I**. Indian Forest Records (n.s.) Timber Mechanics 1(2): 171-184.

Presents figures of physical and mechanical properties of logs of teak from Pyinmana Division Burma. The age of the tree is estimated to vary from 94-124 years. The timber can be classified as heavy, strong, moderately tough and hard.

4235 Orman, H.R. 1948. **Teak grown in Western Samoa**. New Zealand Journal of Forestry 5(5): 430-434.

Includes a comparison of mechanical and physical properties of green teak from Samoa and Burma.

4236 Pahlitzsca, G; Dziobek, K. 1959. **Investigations on belt sanding of wood with a straight cutting movement**. Holz als Roh- und Werkstoff 17(4): 121-134.

The influence of the sanding process of species including teak, fibre direction, size of sanding area, belt speed, pressure and fineness of abrasive was investigated by determining the volume of wood abraded.

4237 Patterson, D.G. 1964. **The colour question in teak and similar timber**. Wood 29(7): 47-48.

A note on the phenomenon of colour changes in freshly machined teak, for which a light-sensitive pigment of a tectoquinone derivative is responsible.

4238 Pearson, R.S. 1911. **Note on the relative strength of natural and plantation grown teak in Burma**. Indian Forest Bulletin 3.

Little difference was reported as regards strength of natural and plantation grown teak from Zigon Division, Burma. The natural grown teak is superior in the test of coefficient of transverse grain, but plantation teak strength is so high.

4239 Pearson, R.S. 1913. **A further note on the relative strength of natural and plantation grown teak in Burma**. Indian Forest Bulletin 14.

Comparative tests to determine the relative strength of plantation grown teak, with that of natural grown teak showed that percentage of moisture in teak has no marked effect when transverse strain is applied.

4240 Pearson, R.S; Brown, H.P. 1932. **Commercial timbers of India, their distribution, supplies, anatomical structure, physical and mechanical properties and uses**. Government of India, Central Publication Branch, Calcutta. Vol. II: 794-796.

Gives notes on common Indian woods including teak.

4241 Prasad, B.N; Jain, N.C. 1964. **Preliminary studies of cutting resistance of a few Indian woods**. Indian Forester 90(10): 698-701.

Describes the apparatus pendulum dynamometer and some preliminary results of tests on a number of species including teak.

4242 Purkayastha, S.K; Tandon, R.D; Rao, K.R. 1973. **A note on the variation in wood density in some 36-year-old teak trees from different seed origins**. Indian Forester 99(4): 215-217.

Studies of increment of *Tectona grandis* from four seed origins in South Coimbatore, and two of the same seed origins in Nilambur, indicated that environmental influences has a greater effect than seed source on the density of the mature wood.

4243 Rajput, S.S; Shukla, N.K; Sharma, R.R. 1980. **Mechanical tests for wood. Comparison of test results on large and small size specimens**. Holzforschung und Holzverwertung 32(5): 117-120.

Comparative tests for static bending, compression parallel to grain and perpendicular to grain, hardness and shear parallel to grain were made on specimens of *Tectona grandis* and other species from three sites. The results were analysed and the ratios of strength properties of large specimens to those of small specimens were calculated.

4244 Rajput, S.S; Shukla, N.K; Sharma, R.R. 1983. **Some studies on the comparison of strength of sapwood and heartwood of teak and kokko**. Journal of the Timber Development Association of India 24(4): 24-30.

Static bending, compression parallel to the grain, hardness, impact strength and green and oven dry density were measured in heartwood and sapwood of *Tectona grandis* and *Albizia lebbek*. The heartwood of both species had significantly better strength properties than the sapwood.

4245 Rajput, S.S; Shukla, N.K. 1986. **A note on the strength-moisture relationship for wood**. Journal of the Timber Development Association of India 32(4): 8-12.

Maximum crushing strength was determined for *Tectona grandis* and other species dried to moisture content of 6-34 percent.

4246 Rajput, S.S; Shukla, N.K; Lal, M. 1991. **Some studies on the variation of strength properties of *Tectona grandis* from Mizoram**. Journal of the Timber Development Association of India 37(2): 33-38.

Results are presented of a study on the variations in physical and mechanical properties of plantation grown teak. Average specific gravity and strength were comparable to values obtained from other localities in India.

4247 Rajput, S.S; Shukla, N.K. 1992. **Status of research on variation of strength of timber in India**. Indian Forester 118(9): 630-637.

A short review is presented of variation in strength properties of timbers including teak. Data are given on the maximum and minimum values found for important strength properties in the green condition, noting the lightest and toughest species. Data on species variation are given for teak and *Eucalyptus hybrid* from various localities, and variation found with age and growth rate are briefly mentioned.

4248 Rawat, B.S; Rana, G.S. 1960. **Mechanical properties of teak from Andamans**. FAO Teak Sub-Commission, New Delhi, 1960, FAO/TSC-60/4.10: 3p.

Presents the results of the tests with comparative data.

4249 Rehman, M.A; Gupta, H.K. 1961. **Shrinkage studies on Indian timbers. Part 1. *Tectona grandis* (teak)**. Indian Forest Records (n.s.) Wood Seasoning 1(3): 29-43.

Presents the results of the studies conducted on shrinkage properties of two logs of girdled Burma teak.

4250 Ryan, A; Kloot, N.H. 1960. **Some notes on the mechanical properties of teak (*Tectona grandis*)**. FAO Teak Sub-Commission, New Delhi FAO/TSC-60/4.8: 4p. Food and Agricultural Organization of UNO, Rome.

The important properties of teak for structural design of both natural and plantation grown teak are tested. In early years of growth, strength properties are low and tend to rise slowly every year till 20 years. Teak grown in certain areas is different from that grown in other areas. Recommendations are made on detailed study of strength by density and strength vs. age diameter relationships.

4251 Sahri, M.H. 2003. **Physical and mechanical properties of thinning materials of teak (*Tectona grandis*) planted in Malaysia**. IUFRO Division 5 Conference, Rotorua, 11-15 March 2003.

4252 Sallenave, P. 1957. **Radial and tangential shrinkage of wood**. (French). Bois et Forests des Tropiques 1957 56: 45-50.

Describes the methods employed for the quantitative determination of radial and tangential shrinkage of wood including teak.

4253 Sallenave, P. 1958. **The wood of African grown teak**. Bois et Forests des Tropiques 57: 37-48.

Samples of teak from the Far East and West Africa are compared for its strength properties.

4254 Sanwo, S.K. 1986. **Intra-tree variations of strength properties in plantation grown teak (*Tectona grandis* Linn.f.) and techniques for their systematic sampling**. Oxford Forestry Institute, University of Oxford, OFI Occasional Papers 31: 41p.

Density, MOR, MOE, total work done and maximum compressive strength parallel to grain were determined in static bending and compression tests of plantation grown teak at Ibadan, Nigeria. Systematic variation was found in oblique, horizontal and vertical sequences.

4255 Sanwo, S.K. 1986. **Prediction of modulus of rupture from modulus of elasticity for plantation grown teak (*Tectona grandis* Linn.f.) in Nigeria**. Journal of Tropical Forest Resources 2: 18-22.

Nominal specific gravity and moduli of rupture and elasticity were determined for green, clear, small, non-standard specimens from a plantation at Ibadan, Nigeria. Simple correlation and regression analysis showed that MOR was highly correlated with MOE. A significant positive correlations between MOR or MOE and SG is also reported. A linear regression model was developed to predict MOR from MOE.

4256 Sanwo, S.K. 1986. **The relationship between rate of growth and strength in plantation grown teak (*Tectona grandis* Linn.f.)**. Journal of Tropical Forest Resources 2: 9-17.

Results of an examination of the relations between rate of growth and wood characteristics such as specific gravity, modulus of rupture, modulus of elasticity, toughness, maximum compressive strength parallel to grain in a plantation at Ibadan, Nigeria are presented. It is reported that the rate of growth has no significant influence on specific gravity and strength properties of plantation grown teak.

4257 Sanyal, S.N; Bali, B.I; Singh, K.R; Sharma, B.D. 1987. **A note on the physical and mechanical properties of plantation grown *Tectona grandis* (teak) from Tanjavur District, Tamil Nadu**. Journal of the Timber Development Association of India 33(4): 15-22.

Plantation-grown teak was classified as heavy, strong, moderately tough, very steady, hard timber. Physical and mechanical properties of this teak were reported better than those of standard teak from Malabar, Coimbatore and Nilambur.

4258 Sanyal, S.N; Saxena, R.C. 1980. **Physical and mechanical properties of some Maharashtra timbers**. Journal of the National Buildings Organisation, India 25(1): 1-5.

Physical and mechanical properties were tested for nine timbers which include teak from Maharashtra in western India. Results are tabulated for green, air-dried and kiln-dried specimens and discussed the relation to working properties and uses.

4259 Sanyal, S.N; Saxena, R.C. 1982. **Physical and mechanical properties of some Maharashtra timbers**. Journal of the National Buildings Organisation, India 27(2): 1-6.

Data are tabulated for timbers including teak.

4260 Sattar, M.A. 1983. **Effects of moisture content and steaming period on the bending properties of teak wood**. Bano Biggyan Patrika 12(1/2): 12-16.

4261 Sattar, M.A; Ali, M.O. 1978. **Shrinkage and density studies of teak of various age groups**. Bano Biggyan Patrika 7(1/2): 82-87.

Density and tangential, radial and longitudinal shrinkage were measured. Both shrinkage and density were independent of height variation with age was small.

4262 Schwab, E. 1986. **Properties of hardwoods in compression perpendicular to grain**. Holz als Roh-und Werkstoff 44(7): 259-269.

Load deformation curves were used to analyse relations between properties measured under compression perpendicular to grain.

4263 Sekhar, A.C. 1960. **Progress report on investigation relating to the mechanical and physical properties of teak at Forest Research Institute, Dehra Dun**. FAO Teak Sub-Commission, New Delhi FAO/TSC-60/4.12: 4p.

Investigations on the mechanical and physical properties of both natural and plantation grown teak specimens were carried out at Dehra Dun. Splitting qualities, shrinkage in natural grown teak and comparative studies on green and kiln dry teak were also investigated. A significant positive correlation is reported existing between specific gravity and maximum crushing strength of teak.

4264 Sekhar, A.C. 1967. **Some Indian timbers equivalent to foreign timbers**. Van Vigyan 5(1/2): 18-24.

Briefly describes reasons for India's dependence on imported timber and wood products, and tabulates the specific gravity and the strength and dimensional stability of sixty six Indian and twenty imported timbers including teak, indicating the manufactured products for which they are suitable.

4265 Sekhar, A.C; Bhatia, D.N. 1957. **Physical and mechanical properties of woods tested at the Forest Research Institute, Dehra Dun: Report VIII**. Indian Forest Records (n.s.) Timber Mechanics 1(9): 155-157.

It deals with the properties of timbers including *Tectona grandis*. Data are recorded for wood in the green state and air-dry.

4266 Sekhar, A.C; Bhatia, D.N. 1959. **Note on the evaluation of splitting coefficients of tim-**

ber. Indian Forest Bulletin 222 (Timber Mechanics): 7P.

Gives the splitting coefficient of common Indian timber including *Tectona grandis*.

4267 Sekhar, A.C; Bhatri, R.K; Rawat, M.S. 1960. **Comparative studies on natural and plantation teak**. Indian Forest Bulletin (n.s.) 227: 10p.

Natural and plantation grown teak from four localities in India and one in Burma were tested for strength properties. No significant differences were identified between natural and plantation teak.

4268 Sekhar, A.C; Gulati, A.S. 1974. **Cleavage properties of some Indian timbers**. Indian Forest Bulletin 269: 20p.

Reports some preliminary studies of cleavage resistance of green wood of *Tectona grandis* using round-notched specimens of various lengths and widths. The effect of specific gravity on cleavage resistance is discussed and suitable equations are proposed.

4269 Sekhar, A.C; Negi, G.S. 1961. **Studies of variation of strength properties in wood. Variation from pith to periphery across the diameter in a tree**. Indian Forester 87(2): 87-93.

Variations from pith to periphery in specific gravity, fibre stress at elastic limit, modulus of rupture, modulus of elasticity, and maximum crushing stress for green wood of different species including *Tectona grandis* are studied.

4270 Sekhar, A.C; Negi, G.S. 1966. **Variation of some mechanical properties along the length of teak trees**. Indian Forest Bulletin (n.s.) 251: 11p.

Variation of strength in stem with position followed the same trend as specific gravity, i.e. strength was greater at the butt and top, and relatively lower in the intermediate positions. The variation was greater in plantation-grown than in natural teak.

4271 Sekhar, A.C; Rajput, S.S. 1970 . **Third report on testing of wood poles**. Indian Forest Bulletin (n.s.) Timber Mechanics 262: 23p.

Gives the results of tests on full length and jointed poles of nine species including *Tectona grandis*. Relations between tests on small specimens and full-length poles have been established. Effects of taper, defects, failures and moisture content have also been studied.

4272 Sekhar, A.C; Rana, R.S. 1957. **Physical and mechanical properties of woods tested at the Forest Research Institute, Dehra Dun. Report IX**. Indian Forest Records (n.s.) Timber Mechanics 1(10): 153-155.

Gives tabulated data on woods including *Tectona grandis*.

4273 Sekhar, A.C; Rana, R.S. 1959. **Physical and mechanical properties of woods tested at the Forest Research Institute, Dehra Dun Report IX**. Indian Forest Records (n.s) Timber mechanics 1(10): 163-165.

Tectona grandis is one of the species for which the physical and mechanical properties has been tested.

4274 Sekhar, A.C; Rawat, B.S. 1956 . **Torsional properties of some Indian timbers**. Indian Forest Bulletin 22: 13p.

Gives basic torsional data on eighty five consignments of woods including *Tectona grandis*.

4275 Sekhar, A.C; Rawat, B.S. 1966. **Physical and mechanical properties of teak from different localities in India and neighbouring areas**. Indian Forest Records (n.s.) Timber Mechanics 1(13): 197-212.

Data on testing of teak for its physical and mechanical properties from different localities in continental India and Burma are tabulated.

4276 Sekhar, A.C; Sanyal, S.N; Sarin, S.P. 1972. **Dynamic modulus of elasticity and pulse constant of wood by pulse transmission technique**. Journal of the Timber Development Association of India 18(4): 19-24.

The dynamic moduli of elasticity and pulse constants of five Indian species including *Tectona grandis* were determined by measuring the velocity of ultrasonic pulses along the grain. Data are given for the pulse velocity in *Tectona grandis* parallel and perpendicular to the grain.

4277 Sekhar, A.C; Sharma, R.S. 1956. **Variation of Izod values with temperature in timber**. Indian Forester 82(1): 45-48.

A study was made of the variation of Izod values with temperature, on standard specimens of seven species including *Tectona grandis*. The test data are tabulated and straight-line equations suggested for each species separately. Slight increases of Izod values with increases in temperature at moisture content above fibre-saturation point were observed.

4278 Sekhar, A.C; Sharma, R.R. 1966. **Nails and screws holding power of some Indian timbers under dynamic conditions**. Indian Forester 92(7): 477-481.

Describes the test method and gives results for timbers including *Tectona grandis* of two provenances.

4279 Sekhar, A.C; Shukla, N.K. 1966. **Creep of wood beams under certain load and its effect on basic strength**. Journal of National Buildings Organisation, New Delhi 11(2): 14-18.

Discusses the results of strength tests on teak beams along with three other spp., before and after deformation under loads.

4280 Sekhar, A.C; Singh, K.R. 1978. **A note on the physical and mechanical properties of *Canarium strictum* Roxb. (dhuna) from Assam**. Indian Forester 104(2): 96-105.

Physical and mechanical properties are tabulated for green air-dry and kiln-dry specimens. Data for teak are included for comparison.

4281 Shigematsu, Y. 1956. **Tests of tropical woods. Part 1. Mechanical properties of seven Philippine woods and two Thai woods**. (Japanese). Scientific Reports of the Saikyo University (Agriculture), Kyoto 8: 20-25.

Compressive strength, bending strength, Young's modulus in bending and hardness are related to specific gravity of *Dipterocarpus* spp. and *Tectona grandis*. Anatomical structure is also found affecting strength.

4282 Shukla, N.K; Rajput, S.S. 1997. **Physical and mechanical properties of Haryana timbers**. Van Vigyan 35(1): 21-29.

Data are tabulated and discussed on the physical and mechanical properties and suitability indices for various utilization characteristics of thirty three timber species including teak grown in Haryana.

4283 Shukla, N.K; Sangal, S.K. 1986. **Preliminary studies on strength properties of some exotic timbers**. Indian Forester 112(5): 459-465.

Physical and mechanical properties including density, modulus of rupture, modulus of elasticity, compression, surface hardness and shear parallel to the grain were recorded for samples of different exotic trees and compared with teak. Teak was found stronger than most of the species.

4284 Sim, H.C; Lopez, D.T; Mohd Arshad, S. 1979. **Sawing of locally grown teak (*Tectona grandis*)**. Malaysian Forester 42(3): 225-229.

Bandsawing trials were made on logs of 10-19 inches mid-diameter from Peninsular Malaysia.

4285 Smeathers, R. 1951. **A comparative study of some of the more important mechanical and physical properties of Trinidad and Burma grown teak (*Tectona grandis*)**. Institute Paper, Imperial Forest Institute, Oxford 27: 19p.

From the mechanical and physical properties tested it is found that the timber grown in the teak plantations of Trinidad is in no way inferior to that of Burma-grown teak. A positive correlation existed between all strength properties and specific gravity.

4286 Sono, P. 1962. **Study on the effects of cross grain on mechanical properties of Thai timbers. Part I. The effects of cross-grain on mechanical properties of Teak (*Tectona grandis*)**. Royal Forest Department, Bangkok 47: 9p. FAO, Rome.

Presents tabulated and graphed results of tests on boards of 40-year teak, with statistical analyses of values obtained for fibre-stress at proportional limit, moduli of rupture and elasticity, maximum crushing strength etc.

4287 Sono, P; Rativanichi, T. 1964. **Comparative study on properties of plantation and natural grown teak in Thailand**. Bulletin, Royal Forest Department, Ministry of Agriculture, Bangkok R. 65: 6p.

Five sample trees from a plantation and from natural forest were tested for physical, mechanical and chemical properties. The only significant differences were in ash content and hot-water solubility, which were respectively greater and less in plantation-grown wood.

4288 Sono, P; Saengsakul, P. 1959. **A Preliminary study on the physical and mechanical properties of different types of teak in Thailand**. Royal Forest Department, Bangkok R 32: 8p.

The so-called sak tong, sak yuak, sak hin, sak khi-kwai possess no statistically significant difference of physical and mechanical properties except sak khi-kwai which shows some significant values in green test.

4289 Sparkes, A.J. 1972. **The strength of teak joints**. FIRA Bulletin 10(37): 10-11.

It is found that the joints of *T. grandis* were generally weaker than those of Beech, probably because of the variable strength properties and the presence of extractives that prevent the formation of a strong bond initially, and loss of strength due to shrinkage under dry conditions. Means of correcting these defects are suggested, including the use of suitable solvents in the glue.

4290 Tamolang, F.B; Rocafort, J.E. 1987. **Physico mechanical properties and possible uses of eleven plantation grown timber species in the Philippines**. FPRDI Journal 16(1/2): 75-85. Forest Products Research and Development Institute, Laguna, Philippines.

Properties studied included relative density, shrinkage, bending, shear parallel to grain, compression parallel and perpendicular to grain, hardness and toughness. Based on the classification of the species in accordance with the five physico-mechanical property teak is recommended for medium construction purposes.

4291 Thomas, A.V. 1940. **Malayan timbers tested in a green condition**. Malaysian Forester 9: 151-157.

A comprehensive table is given of the strength properties of thirty three Malayan timbers in the green condition and corresponding figures for Scots pine, oak and teak are appended for comparison.

4292 Venet, J. 1955. **Wood and warships, merchant vessels and pleasure boats**. (French). Revue du Bois et de ses Applications 10(1): 17-24.

A brief outline of the history of wooden sea-going vessels from the earliest times is followed by a list of the present uses of wood for naval purposes and of the species involved including teak.

4293 Vernay, M. 2000. **Teak in France: What for?** (French). Bois et Forests des Tropiques 263: 31-38.

Teak is used for prestigious purposes such as the interior fittings of boats, parquet flooring, furniture, and many other uses in France. The increase in demand for products seems to be upsetting the market and prompting producers to use younger and younger teak trees in order to meet the demand which led to rise in prices, which go hand in glove with lower product quality.

4294 Wang, S.Y. 1981. **Studies on the properties of wood deterioration (VI) The reduction in strength properties of some Taiwan native species after 4 years exposure in outdoor environment**. Quarterly Journal of Chinese Forestry 14(4): 29-39.

Weathering resistance of samples of seventeen species including *Tectona grandis* was tested by the accelerated method or by exposing them outdoors for four years. Static and impact bending strength were measured as indicators of weathering resistance and decreased linearly with increasing length of exposure to outdoor environment.

4295 Wang, S.Y. 1990. **Reduction of mechanical properties of seventeen Taiwan native-wood species subjected to a seven-year exposure in an outdoor environment**. Journal of the Japan Wood Research Society 36(1): 69-77.

Changes in specific gravity in static and impact bending strengths were used to indicate the weathering resistance of samples including *Tectona grandis*. Effects on the mechanical properties were in the order impact bending strength modulus of rupture modulus of elasticity. Changes in mechanical properties also varied with climate.

4296 Wattankul, S. 1959. **A comparative study on the physical properties of green-felled and girdled teak timbers (*Tectona grandis*)**. Royal Forest Department, Bangkok R.33: 22p.

Results of investigations are summarised and variations in moisture content of green and girdled logs is given at different points of heartwood and also at butt end and top piece of the same log. The variation in moisture content of logs in different seasons of the year is studied.

4297 Williams, R.S; Miller, R; Gangstad, J. 2001. **Characteristics of ten tropical hardwoods from certified forests in Bolivia. Part I: Weathering characteristics and dimensional change**. Wood and Fiber Science 33(4): 618-626.

Ten tropical hardwoods including teak from Bolivia were evaluated for weathering performance. The dimensional change for teak was 1.3 and 2.5 percent for the same change in relative humidity. The erosion rate of several of the wood species was considerably slower than that of teak.

4298 Win Maung, U. 1968. **Comparative load tests on simple timber connectors for Burmese hardwoods**. Union of Burma Journal of Science and Technology 1(3): 499-518.

Presents preliminary results of working-stress tests with wire nails, wood screws, bolts and nuts, and improvised split-ring connectors, used in conjunction with wood of *Tectona grandis* and other species.

4299 Woods, R.P. 1952. **Timber for ships decking**. Timber Development Association, London, Timber Information 42: 2p.

Discusses the results of service tests on timbers including teak laid down as decking.

4300 Yakub, M; Ali, M.O; Bhattacharjee, D.K. 1970. **Strength properties of some East Pakistani woods, some Bangladesh timber species, Chittagong teak *Tectona grandis* representing different age groups**. Bulletin, Forest Research Institute, Bangladesh 1, 1970: 14p; 2, 1972: 12p; 4, 1978: 28p.

4301 Zeeuw, C.H de; Davidson, R.W; Anderson, E.A. 1980. **Properties of the wood of Honduran grown *Tectona grandis* Linn.f., *Eucalyptus deglupta* Blume, and *Pinus caribaea* Morelet**. Procesamiento de maderas tropicales de alta densidad. Acta de la reunion de IUFRO: 22p. Laboratorio Nacional de Productos Forestales, Merida, Venezuela.

Physical and mechanical properties of wood are presented and discussed for plantation-grown *Tectona grandis* and *Eucalyptus deglupta* and for naturally-occurring *Pinus caribaea*. The results showed that, wood density was lower for plantation-grown trees than for naturally-grown trees.

Go top

Chemical Properties

4302 **Chemistry of teak: News and notes**. Indian Forester 93(2), 1967: p136.

Recent German studies indicate that almost all the anthraquinones found in teak wood are effective against termites. But naphthoquinones, especially desoxylepachol are found fungicidal. Some varieties of teak cause unpleasant skin diseases, specially lapachol and depsoxypachol. The high caoutchouc content of the wood is responsible for its good abrasion resistance, its resistance to mineral acids.

4303 **Thailand research team finds trace of gold in teak wood**. Forest Products Journal 18(12), 1967: p11.

Studies conducted by Atomic Energy for Peace, Bangkok show that teakwood contain gold.

4304 Amos, G.L. 1952. **Silica in timbers**. Commonwealth Science Industrial Research Organization Bulletin 267: 55p.

Teak wood contains vitreous silica in the vessels and parenchyma but the amount present in specimens of timbers varies over a wide range.

4305 Aranyaputi, S. 1963. **A study of chemical property of teak**. Vanasarn 21(2): 157-162.

The chemical contents of tectoquinone, lapachol, caout-chouc and tectol in teak were studied in detail and chemical composition presented.

4306 Bhatia, K; Jia Lal; Ayyar, K.S. 1985. **Barks as a source of oxalic acid - I**. Indian Forester 111(7): 538-541.

Of the 31 forest species examined *Tectona grandis* bark is found to have 8.3-15.55 percent of oxalic acid.

4307 Bouda, V. 1968. **Finishing of exotic timbers containing aliphatic and resinous substances in the furniture industry**. (Czech). Drev 23(7): 248-252.

Reports tests on different species including teak.

4308 Bromley, R.F; Rudge, E.A. 1939. **The hardness of teak in relation to its mineral constituents**. Chemistry and Industry Review 58: 279-280 .

It appears probable that the hardness in teak is due to some histological factor, closeness of grain, cell structure or fibre orientation.

4309 Burmester, A. 1971. **Improvement of wood with formaldehyde. I. Influence of various factors on the degree of improvement**. Holz als Roh-und Werkstoff 29(2): 51-56.

Treatment of wood with formaldehyde gas followed by HCl gas leads to improvement in its dimensional stability owing to the formation of chemical bonds with hydroxyl groups in the wood. The reduction in swelling of wood including teak is recorded in relation to the amount of formaldehyde fixed in the wood.

4310 Burmester, A. 1971. **Improvement of wood with formaldehyde. III. Treatment of reactivated heartwood**. Holz als Roh-und Werkstoff 29(5): 184-188.

The product has improved dimensional stability due to cross-linking, the relative tangential swelling being reduced by up to 80 percent. Effects of moisture content of the wood and treatment conditions were investigated.

4311 Burmester, A. 1974. **Dimensional changes in oven dry wood by re-deposition of water soluble substances in the cell wall**. (German). Holz als Roh-und Werkstoff 32(6): 229-233.

Measurements on cubes of species including *Tectona grandis* showed that the oven-dry dimensions were influenced by the method of drying. Changes in dry dimensions after wetting and drying cycles are not due to drying stresses but to distribution of water-soluble substances within the cell-walls.

4312 Coster, C. 1923. **Thickness and contents of stem of *Tectona grandis***. (Indonesian; English). Tectona 16(11/12): 1046-1056.

4313 Councler. 1907. **Chemistry of teak wood**. (German; English). Zeitschrift fur Forst. U-Jagdwesen 39: p814.

4314 Datta, S.K; Kumar, A. 1987. **Histochemical studies of the transition from sapwood to heartwood in *Tectona grandis***. IAWA Bulletin 8(4): 363-368.

Discs from young branches prior to heartwood formation and from older branches with heartwood were separately analysed. Starch, lipids, proteins, nucleic acids, phenolics, peroxidase, succinate dehydrogenase, acid phosphatase, adenosine triphosphatase and glucose-6-phosphatase showed significant changes during the transition.

4315 Devi, R.K.S; Devi, G.A.S. 1990. **Cell wall biochemistry of timbers from Manipur**. Indian Forester 116(10): 843-844.

Contents of cellulose, hemicellulose, lignin and pectin are reported for the wood of seven species including teak, which was ground to a powder after oven drying and then analysed.

4316 Dutt, S. 1961. **Indian oleoresins and their essential oils**. Indian Oil Soap 27(1): 3-10.

A review of the physical and chemical properties of *Tectona grandis* and other species and their oleoresins and essential oils.

4317 Elias, M; Potvin, C. 2003. **Assessing inter and intra specific variation in trunk carbon concentration for 32 neotropical tree species**. Canadian Journal of Forest Research 33(6): 1039-1045.

Trunk carbon concentrations were assessed for 32 species of tropical trees including teak to understand sources of variation. Teak demonstrated the greatest C concentration. C concentration was highly correlated with specific gravity of wood.

4318 Faix, O; Meier, D. 1989. **Pyrolytic and hydrogenolytic degradation studies on lignocellulosics, pulps and lignins**. Holz als Roh-und Werkstoff 47(2): 67-72.

Wood and milled-wood lignin from species including teak wood and teak HCl-lignin were subjected to analytical pyrolysis. The results are compared with those of nitrobenzene oxidation and quantitative non-degradative FTIR-spectroscopy. It is concluded that analytical pyrolysis of biomass is well suited for lignin classification even without previous lignin isolation.

4319 Forest and Forest Products Research Institute, Japan. 1978. **Properties of some Papua New Guinea woods relating with manufacturing processes. VII. Chemical properties of some West New Britain woods**. (Japanese). Forest and Forest Products Research Institute, Japan, Bulletin 299: 85-104.

Results are tabulated for successive extraction with n-hexane, ether, acetone and methanol. Discoloration was investigated in response to ferrous ions, alkali, acid, and exposure to sunlight.

4320 Griffoen, K. 1950. **Carbonization of some Indonesian woods in an electrical laboratory oven**. (Dutch; English). Tectona 40: 241-258.

Gives the properties of charcoal and ash of teak wood.

4321 Gupta, R.C; Jain, D.K. 1980. **Role of extractives in the development of bond strength**. Indian Forester 106(8): 565-568.

Lap joints were made with cold-set UF resin of sawn and sanded strips of species including teak after extraction in hot water, ether, ether and benzene/alcohol and combined ether and benzene/alcohol and hot water. Extraction in hot water reduced bond strength after 7 days whereas in ether, ether and benzene/alcohol and combined ether and benzene/alcohol and hot water it was increased.

4322 Hausen, B.M; Simatupang, M.H; Tamolang, F.N. 1979. **Naturally occurring quinones in tropical woods as allergenic agents**. Wood quality and utilization of tropical species. Proceedings of IUFRO conference, Laguna, 30 October-3 November 1978: 74-82. Forest Products Research and Industries Development Commission, Laguna, Philippines.

Some 10 allergenic quinones are discussed in relation to the species including teak in which they occur and their effects. A table is given of tropical woods that contain quinones implicated in contact allergies.

4323 Hillis, W.E; De Silva, D. 1979. **Inorganic extraneous constituents of wood**. Holzforschung 33(2): 44-53.

4324 Hirano, Y; Kondo, R; Sakai, K. 2001. **Compounds inhibitory to rat liver 5alpha-reductase from tropical commercial wood species: Resveratrol trimers from melapi (*Shorea* sp.) heartwood**. Journal of Wood Science 47(4): 308-312.

5alpha-Reductase inhibitory activity of methanol extracts of the heartwood of thirteen tropical wood species including *Tectona grandis* were examined.

4325 Kafuku, K; Sebe, K. 1963. **On tectoquinone, the volatile principle of the teak wood**. Bulletin Chemical Society, Japan 7: 14p.

4326 Kanazawa, H; Nakagami, T; Nobashi, K; Yokota, T. 1978. **Studies on the gluing of the wood articles. XI. The effects of teak wood extractives on the curing reaction and the hydrolysis rate of the urea resin adhesive**. Mokuzai Gakkaishi Journal of the Japan Wood Research Society 24(1): 55-59.

The methanol-insoluble fraction of the hot water extract of teak retarded the gelation of a urea resin adhesive. Inhibition was attributed to Ca, Mg and K salts of acidic sugars, which have a buffering action on the glue hardener system. The methanol-soluble fraction of the extract increased the rate of hydrolysis of the cross-linked cured urea resin, owing to its acidity.

4327 Karnik, M.G; Bhatia, K; Dobhal, P.C. 1970. **The proximate chemical composition of barks of some Indian trees: Part I**. Indian Forester 96(4): 314-317.

The bark of *Tectona grandis* and other species were analysed for tannins, cold-water solubility, hotwater solubility, ash, peat, ether extractives, alcohol benzene extract, pentosans, lignin and chlorite holocellulose content following standard methods. The barks were also tested qualitatively for starch and alkaloids.

4328 Karnik, M.G; Gupta, A.C. 1966. **Significant chemical components of Indian teak (*Tectona grandis* Linn.f.)**. Indian Pulp Paper 20(8).

Based on chemical studies of major constituents of Indian teak wood, extractives of lignin, total carbohydrates, hemicellulose, pentosans, ash, acetyl content and silica in the wood were estimated. The wood was also tested qualitatively for sugars, starch, alkaloids and tannins.

4329 Kawamura, F. 1999. **Components of tropical trees and their utilization (7) Food colourants**. Tropical Forestry 44: 77-80.

Different species are used which include *Tectona grandis*.

4330 Kawazu, K; Marwani, E; Kobayashi, A; Nitoda, T; Kanzaki, H. 1998. **Production of antibacterial triterpene acids not detected in the native plant by cell suspension culture of *Tectona grandis***. Faculty of Agriculture, Okayama University, Scientific Reports 87: 9-12.

The paper reports the production of the antibacterial compounds in much higher amounts by cell suspension culture.

4331 Khan, R.M; Mlungwana, S.M. 1999. **5-Hydroxylapachol: A cytotoxic agent from *Tectona grandis***. Phytochemistry 50(3): 439-442.

A new compound, 5-hydroxylapachol, lapachol, dehydro-alpha-lapachone, methylquinizarin and squalene, were isolated from the root heart wood of *T. grandis*.

4332 Kraenzel, M; Castillo, A; Moore, T; Potvin, C. 2003. **Carbon storage of harvest age teak (*Tectona grandis*) plantations, Panama**. Forest Ecology and Management 173(1-3): 213-225.

Estimated carbon content of 20- year old teak trees in four Panamanian plantations. Various methods of estimation of carbon storage in short rotation plantations are discussed.

4333 Kristensen, P; Boye, C; Jensen, B. 1965. **Testing dowels**. (Danish). Troeindustrien 15(2): 15-19.

Studies the effect of type of glue and method of gluing and type of dowel on strength of dowelled joints in beech and teak.

4334 Lee, C.L; Nakatsuka, T. 1972. **Effect of methanol extractives of woods on the curing characteristics of unsaturated polyester resins at 25 degree C**. (Japanese). Mokuzai Kogyo Wood Industry 27(6): 17-21.

Curing of the resins was delayed by the addition of 1 percent of methanol extractives of most of the 14 softwood and 4 hardwood species examined. Considerable delay was observed with extractives from species including *Tectona grandis*.

4335 Lii, W.J; Liu, C.T. 1991. **Effect of physico-chemical properties and gluing methods on the qualities of laminated wood made from fast-growing species (12). Studies on the fabrication of end-to-end grain joint laminated wood from Taiwan red pine, Honduras mahogany and common teak**. (Chinese). Forest Products Industries 10(1): 25-34.

Bending strength was compared of laminated wood made from teak and other species with butt, scarf or finger joints at different locations.

4336 Moredo, C.C Jr; Sakuno, T; Kawada, T; Furukawa, I. 1990. **Effect of extractives on gluability of wood. I. Gluability of some tropical woods after solvent extraction**. Journal of the Faculty of Agriculture, Tottori University 26: 19-28.

Wood extractives of different species including teak were removed by solvent extraction in a study to determine whether removal of extractives would improve gluability. Wood block samples, treated and untreated, were bonded with isocyanate, resorcinol and polyvinyl acetate resins and their glue bond strength properties were investigated.

4337 Narayanamurti, D (et al). 1962. **Extractives in teak**. Silvae Genetica 11(3): 57-63.

Disks from the butt end of trees of 10, 30 and 62 years old were investigated along the radius for variations in extractive content and durability.

4338 Narayanamurti, D; Singh, J. 1960. **Caout chouc in teak**. Composite Wood 7(4): 39-41.

Describes preliminary studies made at Dehra Dun, in which specimens of Burmese and Indian grown teak were examined for their caoutchouc content. Results indicated that bending strength, moisture resistance and dimensional stability are adversely affected by removal of caoutchouc but the modulus of elasticity is improved.

4339 Narayanamurti, D; Singh, J. 1964. **Note on caout chouc in teak**. Silvae Genetica 13(5): 140-141.

Compares the caoutchouc content of wood from three seed origins, Mysore, Mount Stuart and S. Burma. Wood from Mysore is found having the highest content.

4340 Narayanamurti, D; Verma, G.M. 1963 . **Nature and distribution of extractives in Indian wood species**. (German). Holz als Roh- und Werkstoff 21(5): 177-80.

The distribution of hot-water, ethanol/benzene and ether extractives in species including *Tectona grandis* is shown in tables.

4341 Narayanamurti, D; Verma, G.M. 1964. **Role of wood extractives in the rheological properties of wood**. Holzforschung und Holzverwertung 16(3): 51-55.

Investigated the effect of the content of extractives, the type of extraction, and the position in the stem, on the moduli of rigidity and elasticity, and damping capacity of the wood including teak.

4342 Narayanamurti, D; Verma, G.M. 1964. **The effect of wood extractives on enzymes of wood destroying fungi**. Holztechnologie 5(1): 33-40.

Hot-water, alcohol/benzene, ether and methanol extracts from species including *Tectona grandis* were tested in varying concentrations on extra-cellular enzymes of *Polystictus versicolor* and *Ganoderma lucidum*.

4343 Narayanamurti, D; Verma, G.M. 1964. **The role of wood extractives in the natural durability of wood**. Holzforschung und Holzverwertung 16(1): 1-13.

Sapwood and heartwood samples from different heights in the stems of species including *Tectona grandis* were extracted with hot water, alcohol/benzene, ether and methanol and then exposed to attack by various fungi after which their weight and strength were determined.

4344 Nearn, W.T. 1955. **Effect of water soluble extractives on the volumetric shrinkage and equilibrium moisture content of eleven tropical and domestic woods**. Bulletin of Pa. Agricultural Experimental Station 598 (Forestry School Series 2): 38p.

Determined the effect of extractions on the volumetric shrinkage of certain species that show an abnormally low volumetric shrinkage for their specific gravity. The species investigated include *Tectona grandis*.

4345 Newman, R.H; Hemmingson, J.A; Bayoumi, A.A.M.S. 1990 . **Determination of the degree of crystallinity in wood by carbon-13 nuclear magnetic resonance spectroscopy**. Holzforschung 44(5): 351-355.

A method for determining the degree of cellulose crystallinity exploits differences in proton rotating-frame relaxation time constants for cellulosic and non-cellulosic domains within samples of wood. A survey of woods from species taken have mean cellulose crystallinities of 0.54 for six hardwoods including *Tectona grandis*.

4346 Nilaubol, M.L.A; Siriaupotham, Ch. 1971. **Neutron activation analysis of gold in teak (*Tectona grandis*)**. (English; Thai). Proceedings of the Second Forestry Conference, Royal Forest Department R.129: 553-561.

The amount of gold in teak has been determined by using neutron activation technique. The spectrum of the energy peak of gold was identified a gamma multi-channel pulse height analyser. In teak especially Na, Ag, Cu, Mn, and La were interfering elements in the energy region. The variation is attributed to different environments in which teak grows.

4347 Nurhayati, T. 1999. **The properties of distillate obtained from destructive distillation of 4 wood species and their prospect for utilization as pesticide**. (Indonesian). Buletin Penelitian Hutan 17(3): 160-168.

Distillates obtained from destructive distillations of species including teak are all assumed utilizable as pesticide active components. Their utilization is based on their chemical constituent such as phenol, ethanol, acetic acid, etc. The study on the properties of the distillates covered physico-chemical and biological analyses on several pests and plant diseases.

4348 Panayotov, P; Stoyanov, D; Kjulanova, S. 2000 . **Determination of the quantity of flavonoids in plant extracts by UV-spectrophotometry**. Lesotekhnicheski Universitet. Yubileen sbornik nauchni dokladi: 75 godini visshe lesotekhnichesko obrazovanie v B"lgariya. Sektsiya Gorsko stopanstvo. 260-265. N. Pipkov; P. Zheler; I. Draganova, Eds. University of Forestry, Sofia, Bulgaria.

Wood extracts are essential for the resistance against wood-destroying fungi. These are mainly polynuclear compounds -- polyphenols. It has been found that they are mainly tannins and flavanols. This paper presents the results of an investigation on the quantities of flavonols contained in extracts of teak determined with the help of UV-spectrophotometry, with rutin being used as an indicator.

4349 Pandey, K.K; Upreti, N.K; Srinivasan, V.V. 1998. **A fluorescence spectroscopic study on wood**. Wood Science and Technology 32(4): 309-315.

Fluorescence spectroscopy has been suggested as an important tool for identification of timber. Investigations on the measurements of fluorescence excitation and emission spectra from solid wood blocks, powder and their extract in methanol from heartwood of species including *Tectona grandis* were made.

4350 Pavanaram, S.K; Row, L.R. 1957. **Chemical examination of *Tectona grandis* Linn.f.: Part 1 - Isolation of 3-hydroxy-2-methylanthraquinone**. Journal of Science and Industrial Research, India 16B(9): 409-411.

Three compounds were isolated from heartwood: Quinone, 2-methyl anthraquinone and a colourless neutral compound.

4351 Premrasme, T; Dietrichs, H.H. 1967. **Nature and distribution of extractives in teak (*Tectona grandis* Linn.f.) from Thailand**. Natural History Bulletin of the Siam Society 22(1/2): 14p.

The type, quantity and distribution of extractives in teak were examined in radial samples cut from cross-sections of teak trees from Thailand, by ethanol extraction and chromatographic spotting. The results help to explain such peculiarities as the lower quality of sapwood, the greater termite-resistance of stem- than of branchwood, the variable results of analyses for properties injurious to health, etc. The possibilities of control of timber quality and chemical properties in the cultivation of teak are briefly discussed.

4352 Purushotham, A; Tewari, M.C. 1958. **A note on the reduction of dichromates into**

chromates in timber. Journal of Timber Dryers' Preservation Association 9(1): 2-6.

Gives brief details of a systematic study of the mechanism of fixation of $Na_2Cr_2O_7$ and $K_2Cr_2O_7$ in wood based on impregnation of sawdust samples of species which include *Tectona grandis*. The main results showed that hexavalent chromium to trivalent chromium in case of teak was found to be about 18 percent.

4353 Ranganathan, S.K; Koshi, T; Sitaraman, N.L. 1949. **Methyl anthraquinone (tectoquinone)-a synergist for 2,2-bis (p-chlorophenyl)-1,1,1-trichloroethane (D.D.T.)**. Nature 164(4182): p1095.

Investigations have shown that it is possible to increase the potency of glass plates treated with DDT by storing them previously in a box made of Burma teak. Experiments showed that beta-methyl anthraquinone used against *Culex fatigans* did not kill but the addition of 5 percent by weight to DDT produced a striking increase over the kill of DDT.

4354 Romanis, R. 1887. **Certain products from teak**. Journal of Chemical Society 54: p868.

4355 Rudman, P. 1960. **Anthraquinones of teak (*Tectona grandis* Linn.f.)**. Chemistry and Industry 44: 1356-1357.

2-hydroxymethyl-anthraquinone, anthraquinone-2-carboxylic acid and anthraquinone-2-aldehyde were identified by paper chromatography following fractionation. The contribution of the anthraquinones to the colour change in freshly sawn teak or fresh sawdust is discussed.

4356 Rudman, P; Costa, E.W.B da. 1959. **Variation in extractive content and decay resistance in the heartwood of *Tectona grandis* Linn.f.** Journal of the Institute of Wood Science 3: 33-42.

The relationship between age, rate of growth, extractive content and decay resistance of teak heartwood has been studied. A significant degree of correlation has been demonstrated between decay resistance of teak heartwood and age, rate of growth and extractive content. Its natural decay resistance has been shown to be due to the presence of extractives.

4357 Sandermann, W; Braun, D; Augustin, H. 1965. **Unusual mineral inclusions in tropical woods**. (German). Report from Holz als Roh-und Werkstoff 23(3): 87-96.

Discusses chemical, X-ray and spectroscopic analyses of hard and soft inclusions in different species which include *Tectona grandis*. Some rare elements found are listed.

4358 Sandermann, W; Dietrichs, H.H. 1957. **Extraneous materials: The cause of wood peculiarities. Results of chromatographic analyses**. (German). Umschau, Frankfurt am Main 57(7): 197-200.

The investigation aimed at the isolation of active substances from the extractives of termite-resistant woods. A technique is described using cardboard which permits the isolation by elution of quantities sufficient for termite testing and further analysis. The content of tectoquinone in teak was greatest in the central heartwood. Tectoquinone content of teak from various regions corresponded well with the known termite-resistance ratings.

4359 Sandermann, W; Dietrichs, H.H. 1960. **Chemical studies of tropical woods. Part 4. Chemical investigation of teak wood**. Holzforschung 13(5): 137-148.

4360 Sandermann, W; Dietrichs, H.H; Simatupang, M.H; Puth, M. 1963. **Caout chouc containing woods**. Holzforschung 17(6): 161-168.

The method of extraction and identification by infra-red spectra was described. Teak is one of the species containing the caoutchouc in the parenchyma of xylem and also in heartwood. The hydrophobic properties of caoutchouc lend the wood certain technological properties and importance, showing high durability resistance to chemical attack and slow water absorption.

4361 Sandermann, W; Gerhardt, U; Weissmann, G. 1970. **Investigations on volatile organic acids in various wood species**. Holz als Roh-und Werkstoff 28(2): 59-67.

The amounts of volatile free fatty acids in woods of six species including teak were determined and the acids were analysed by gas chromatography. Varying amounts of formic, acetic and propionic acids and in some cases, butyric, crotonic and acrylic acids were produced. The importance of the free acids in influencing technical processes is discussed.

4362 Sandermann, W; Simatupang, M.H. 1961. **The chemistry of teak, an unusual wood**. (German). Chemiker-Zeitung, Kothen 85(2): 38-43.

Presents data on the chemical constituents of teak wood, their biogenesis and distribution over the stem cross-section, the connexion between the nature and amount of the constituents and the properties of the wood, the origin of Indonesian teak and analysis of teak wood from India and Java. The possibilities of impregnating ordinary woods with caoutchouc and quinone to make an artificial teak and selecting teak seed trees according to the results of chemical wood analysis of increment cores are pointed out.

4363 Sandermann, W; Simatupang, M.H. 1962. **A toxic quinone from teak wood**. (German). Angewantdtechem. 74(20): 782-783.

Certain teak logs which caused itching and eczema among workers in a German veneer mill were found to contain a substance identified as gamma-gamma-dimethylallyl-1,4 naphthoquinone.

4364 Sandermann, W; Simatupang, M.H. 1963. **Teak extractives. I. Isolation and constitution of a toxic teak quinone**. Chemische Berichte 96(8): 2182-2185.

Discusses constituents of teak wood and they differ in different localities. A new substance detected in a sample from India and a Javanese teak, which was identified as a naphthoquinone.

4365 Sandermann, W; Simatupang, M.H. 1963 . **The structure of the tectols and dehydrotectols in *Tectona grandis***. (German). Tetrahedron Letters, London 19: 1269-1272.

4366 Sandermann, W; Simatupang, M.H. 1965. **New quinones from *Tectona grandis***. (German). Naturwissenschaften 52(10): 262-263.

Three further quinones were found.

4367 Sandermann, W; Simatupang, M.H. 1966. **The chemistry and biochemistry of teak wood (*Tectona grandis*)**. (German). Holz als Roh-und Werkstoff 24(5): 190-204.

A compilation of information from world literature on the chemical constituents of teak wood, listing 41 compounds so far discovered, with their chemical formulae and literature references. Particular attention is paid to the quinones, terpenoid compounds, tectol and dehydrotectol, other naphthalene derivatives, fatty acids, the biogenesis of the compounds, the causes of the natural durability of the wood, contact eczemas and their causes, the technical importance of the compounds and the possibilities of chemical selection of mother trees.

4368 Sandermann, W; Simatupang, M.H. 1967. **Another biogenetically interesting compound from *Tectona grandis***. (German). Naturwissenschaften 54(5): p118.

Purification and examination of the oily neutral compound obtained from teak has led to the structural identification of the substance as 2, 2-dimethylnaphthochromane.

4369 Sandermann, W; Simatupang, M.H. 1978. **Chemistry and biochemistry of teakwood (*Tectona grandis* Linn.f.)**. Holz als Roh-und Werkstoff 24(5): 190-204. Institute of Paper Chemistry, Appleton, USA.

4370 Savard, J; Lecoche, D. 1968. **The action of wood on copper and aluminium**. (French). Bois et Forests des Tropiques 12O: 37-48.

A study of the action of aqueous extracts of eleven tropical hardwoods which include teak on Cu and Al. The corrosive potential of the wood extracts was much less on Cu than on Fe although the effects varied considerably between woods.

4371 Savard, J; Nicolle, J; Andre, A.M. 1959. **Chemical analysis of tropical woods. Vol. II**. Publication Centre Tech. For. Tropical 16: 250p.

Presents a detailed account of further studies on chemical analysis which include the application of paper chromatography to the analysis of wood and pulp, corrected cellulose by the Kurschner and Hoffer and the Seifert methods, determination of uronic acids, decarboxylation with 19 percent HCl, influence of xylans on decarboxylation, determination of functions of acids in bleached pulp, determination of holocellulose and of lignin.

4372 Schultz, K.H. 1962. **Sensitizing effect of the chemical components of tropical woods**. Berufsdermatosen 10: 17-37.

Acute contact eczema attributed to tectoquinone and lepachol found in wood dust of *Tectona grandis* is found to cause sensitizing effect.

4373 Schultz, K.H. 1965. **Allergic contact dermatitis due to tropic woods**. (German). Dermatology International 4(2): 121-124 .

A variety of woods, such as teak, from tropical and sub-tropical areas have been imported into Europe for use in the manufacture of furniture, ships, railroad cards, musical instruments, jewellery, knife handles and similar objects, which caused inflammatory manifestations of the skin and the mucosa of the respiratory system, the mouth and the digestive system as well as of the ocular tissue.

4374 Sekhar, A.C; Negi, D.D.S. 1955. **Studies on Izod values of some Indian timbers**. Indian Forest Bulletin 201 (Timber Mechanics) : p20.

The importance of Izod tests in timber including teak were discussed and various causes of variation have been pointed out and values given.

4375 Ser, C.S; Neo, S.L. 1982. **The susceptibility of some Malaysian timbers to iron stains**. Malaysian Forester 45(3): 425-430.

A test procedure using nails is described and results are reported for twenty seven species. Teak was found free from iron-tannate stain under damp conditions. No close correlation was found with wood chemical properties.

4376 Shah, R; Singh, T.C.N. 1944. **A preliminary note on the application of absorption-spectroscopy to timber wood extracts**. Current Science 13: 178-179.

Thin fine shavings of the woods of *Pterocarpus marsupium*, *Tectona grandis*, *Gmelina arborea* and *Boswellia serrata* were boiled separately in equal volumes of tap water for 15 minutes, subsequently cooled and filtered. These liquids were each subjected to spectroscopic examination and spectrograph of their absorption spectrum was taken in an arc light emitted from iron electrodes. The absorption spectra were shown to be very clear and characteristic for each species.

4377 Sharma, M. 1971. **A note on silica content in teak**. Journal of the Indian Academy of Wood Science 2(1): 25-26.

Analysis of samples of *Tectona grandis* from 23 localities in India and Burma showed that silica occurs only in the fibres and vessels, and is always of the vitreous type.

4378 Shinohara, T; Goto, T; Sakuno, T. 1967. **Studies on the wood gluing. II. Microscopic observation of glue line in tropical woods glued with phenol formaldehyde resin adhesive. (Preliminary report)**. (Japanese). Bulletin of Shimane Agriculture College 15A-2: 61-67.

Reports tests on eighteen species including teak.

4379 Simatupang, M.H. 1963. **Isolation and constitution of a toxic teak quinone**. Chemical Abstracts 59 No. 11366b.

A toxic quinone was isolated from various health damaging teak varieties and identified by degradation and synthesis as 2-(3, 3-di-methylallyl), 1, 4-naphthoquinone.

4380 Simatupang, M.H. 1964. **Chemical investigation of teak wood**. Dissertation, University of Hamburg, West Germany.

4381 Simatupang, M.H. 2003. **Deoxylapachol, the allergenic agent in teak, a potential threat?** International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

The less desirable properties of teak are inhibition the hardening of lacquers based on radical polymerization, occurrence of calcium phosphate inclusions and inducing dermatitis and allergenic reactions. The cause and occurrence of these health injurious effects are reviewed.

4382 Simatupang, M.H; Rosamah, E. 1996. **Importance of teakwood extractives to wood properties and tree breeding**. Forestry and forest products research: Proceedings of the Third Conference, Kepong, 3-4 October 1995, Volume 2: 235-246. K. Yamamoto; A.M. Abdul Rashid; Abdul Rahim Nik; A. Mohamad; Lee Su See; Wong Han Hoy; Khoo Kean Choon, Eds. Forest Research Institute Malaysia, Kuala Lumpur.

The wood is of medium density, has very good dimensional stability, prevents iron nails from rusting, is rather resistant against chemicals, and has a high natural durability against wood destroying fungi and termites. The termiticidal properties are due to anthraquinones. Caoutchouc is the most abundant occurring compound in teakwood. The compound is responsible for the water repellent properties of the wood. The synergistic effect of active and non-active wood extractives is the cause of the durability against wood destroying fungi. A new antioxidant was recently isolated from the acetone extract of teakwood and this compound protects against oxidation and rusting of iron nails.

4383 Simatupang, M.H; Yamamoto, K. 2000. **Properties of teakwood (*Tectona grandis***

Linn.f.) and mahogany (*Swietenia macrophylla* King) from manmade forest and influence on utilization. Proceedings of the seminar on high value timber species for plantation establishment - teak and mahoganies, Sabah, Malaysia, 1-2 December 1998. H.H. Chan; K. Matsumoto, Eds. JIRCAS-Working-Report 16: 103-114.

The wood and timber properties of teak and mahogany, especially those influenced by wood extractives, are briefly reviewed, because the advantageous as well as the less desirable characteristics are mostly due to these compounds.

4384 Singh, P; Jain, S; Bhargava, S. 1989. **A 1,4-anthraquinone derivative from *Tectona grandis***. Phytochemistry 28(4): 1258-1259.

4385 Venkateswara Rao, D; Narayan Nambiyar, V.P. 1946. **Light-scattering in aqueous timber wood extracts**. Current Science 15(1): 19-20.

A study of the factors of depolarisation of the light transversely scattered in aqueous timber wood extracts is capable of yielding reproducible and characteristic values for each specimen and would also throw valuable light on the state of dispersion in the medium of the scattering elements. The results of investigation are given and show that the method of light scattering in aqueous timber wood extracts can be relied upon for the identification of timbers.

4386 Vermeer, D.J.M; Dejong, J.C; Lenstra, J.B. 1949. **Occupational eczema through teak wood**. Netherlands Tijdschr. Geneesu 93: 2338-2344.

Five persons hypersensitive to peroba teak wood who got occupational eczema are described.

4387 Wise, L.E; Rittenhouse, R.C; Dickey, E.E; Olson, O.H; Garcia, C. 1952. **The chemical composition of tropical woods**. Journal of Forest Products Research Society 2(5): 237-249.

Teak along with other woods were subjected to qualitative and quantitative analysis.

4388 Yatagai, M. 1999. **Components of tropical trees and their utilization (8) Physiologically active substances**. Tropical Forestry 45: 50-55.

An account is given of physiologically active substances derived from a variety of tropical tree species including *Tectona grandis*.

4389 Yonenobu, H; Kikata, Y; Morishita, F; Hattori, Y; Marsoem, S.N. 1994. **14C concentrations in tree stems II**. Journal of the Japan Wood Research Society 40(6): 627-630.

Concentrations of 14C were measured in stems of teak from Java and Indonesia along with other species. Statistical analysis showed that there is no significant difference in trees of the same species. Latitude had an effect on 14C concentration.

Go top

Wood Working Properties

4390 **Mysore teak: Extract from Indian engineering**. Indian Forester 16, 1890: p248.

Compares Mysore and Malabar teak woods with that of Rangoon and recommends use of Mysore wood for ship building.

4391 **Belt sanding of beech, oak, teak and palisander (*Dalbergia* spp.)**. Tree Industrien 16(6), 1966: 86-89.

Makes recommendations for each species on method and grade of abrasive to give a satisfactory surface.

4392 **Hardwoods for joinery and construction: Test results and recommendations**. BRE Digest 431, 1998: 16p. Building Research Establishment, Watford, UK.

Results are presented for tests of wood properties, durability and sawing and woodworking characteristics for different hardwoods including *Tectona grandis*.

4393 Ayarkwa, J; Addae Mensah, A. 1999. **Processing of small diameter logs: Effect of log diameter, sawing pattern and some bole variables on lumber recovery**. Ghana Journal of Forestry 8: 43-51.

The effect of log diameter, sawing pattern, log length and log stem form on lumber yield have been studied with a view to finding the most efficient processing technique for small diameter plantation grown teak logs in Ghana. The study has shown that there are significant differences between lumber yields from log diameter classes 10-20, 21-30 and 31-40 cm, and that larger log diameters generate higher lumber yields than smaller log diameters. The results of the study indicate that small diameter plantation grown logs of 30 cm diameter can be efficiently processed to give improved yields, if suitable sawing methods are adopted.

4394 Bhat, K.M. 1999. **Need for technology transfer to producer countries for processing small dimensional timbers of teak plantations**. Proceedings of the 14th International Wood Machining Seminar, Paris, 12-19 September 1999: 281-290.

The current level of technology for sawing, veneer and glulam composite product manufacture from small dimensional timbers of teak plantations in developing countries particularly India is examined. There is a need for technology transfer to increase the level of technology in mechanical wood industries that allows the use of smaller and younger trees.

4395 Butterwick, A.J. 1917. **Stray notes the working of teak in Burma**. Indian Forester 48(11/12): 488-498.

Discusses the details of the operations for efficient working and regeneration of teak forests in Burma.

4396 Chelvarajan, B.K. 1957. **Nail holding power of a few Mysore woods on a mohr-and Federhaff Universal testing machine**. Indian Forester 83(4): 260-264.

Gives nail holding power of thirty four species of woods including teak. Oily-woods like teak, sandal, etc. have lower values compared with woods of similar specific gravity.

4397 Chugg, W.A; Wood, T; James, P.E. 1965. **The gluability of hardwoods for structural purposes**. Timber Research Development Association, London, Research Report E/RR/22: 18p.

An investigation of the gluability of nineteen hardwoods including teak is made to determine their suitability for use in glued timber components.

4398 Endom, W; Mammen, M. 1991. **Problem of log split in teak forest operation**. Forest Products Research Journal 9(3): p3.

4399 Goto, T; Sakuno, T; Onishi, H. 1967. **Studies on the wood gluing. I. On the gluability of tropical woods (Part 1)**. (Japanese). Bulletin of Shimane Agriculture College 15A-2: 53-60.

Presents the results of tests on woods including *Tectona grandis*.

4400 Hansen, W. 1964. **Wood finishes in furniture**. Wood 29(12): 50-52.

Describes recent development in Denmark and Sweden, particularly teak which is treated with either a quick-drying oil, special acid-hardening teak lacquer or thin polyurethane lacquer and machine or hand sanded. The best appearance is given by quick drying oil.

4401 Hon, L.Y; Lopez, D.T. 1968. **Machining properties of some Malayan timbers**. Malaysian Forester 31(3): 194-210.

Describes briefly the tools and machines used for determining four machining properties of timbers viz. sawing, planing, boring and turning. Teak is one of the test materials included in the study.

4402 Hwang, G.S. 1985. **Bonding test of wood at high moisture content**. (Chinese). Taiwan Forestry Research Institute, Bulletin 447: 10p.

Woods of different species including *Tectona grandis* were glued using resorcinol, polyurethane or epoxy resins at 12, 30 or 60 percent moisture content.

4403 Kamil, R.N. 1970. **Prefabricated houses and prospects of their development in Indonesia**. (Indonesian). Pengumuman, Lembaga Lembaga, Penelitian Kehutanan 97: 138p.

Gives a detailed account of the technology of prefabricated house construction, especially with wood-based materials and describes a system developed at the Forest Products Research Institute, Bogor. A roofing panel consisting of 25 *Tectona grandis* shingles is developed. Proposals are made for setting up a prefabricated-house factory in Java.

4404 Kanazawa, H. 1978. **Inhibition of adhesion with tropical woods: The case of teak wood**. (Japanese). Tropical Forestry 49: 15-19.

4405 Lalitha, H.C; Victor, V.J. 1971. **A method for the measurement of adhesion tension of liquids in contact with wood**. Journal of the Indian Academy of Wood Science 2(2): 84-88.

Describes an apparatus for measuring the rate of capillary penetration into wood specimens including *Tectona grandis* and shows how the data may be used to calculate adhesion tensions between the liquids and these species.

4406 Limaye, V.D. 1946. **Safe working stresses of Indian timbers (cf. *Tectona grandis*)**. Indian Forest Records (n.s.) Utilization 4(1).

4407 Mottonen, V; Asikainen, A; Malvaranta, P; Oykkonen, M. 2003. **Peroxide bleaching of parquet blocks and glue lams**. Holzforschung 57(1): 75-80.

A method of bleaching of wood in the wood working industry, using hydrogen peroxide solution was investigated. In this method, the lightness could be increased of all the wood species tested. In the case of teak, the redness could be increased markedly.

4408 Munz, W. 1959. **The surface treatment of teak furniture**. (German). Holztechnik 30(10): 37-38.

Discusses the mechanical preparation of the surface, and the oiling of the wood.

4409 Narayanamurti, D; Singh, K. 1962. **Sanding qualities of Indian timber: Preliminary investigation**. Paintindia 12(2): 23-24.

Describes preliminary results of sanding qualities of some Indian timbers including *Tectona grandis*. Tests were done on teak samples of different rubber content. The results indicate that the wear resistance increases with coutchouc content and higher the coutchouc content the smoother the surface.

4410 Pandey, C.N; Joshi, N; Swaroop, C. 2002. **Embossing on wood - an alternative technique to wood carving**. Journal of the Timber Development Association of India 48(3/4): 24-26.

The embossing behaviour of different species includes *Tectona grandis* after plasticization with vapour phase ammonia was evaluated to determine the optimum treatment periods, the ammonia absorption and minimum pressing pressure and time required to produce clear impression on the surface of the wood.

4411 Pandey, C.N; Rao, P.V.K. 1995. **Wood softening and bending with ammonia**. Wood News 5(1): 29-31.

The woods of six commercially important Indian timber species including teak gave satisfactory bends of radius 100-175 mm in 13 and 25-mm-thick strips when plasticized with ammonia at 5 kg/cm2 pressure.

4412 Patil, Y.P; Gajre, B; Dusane, D; Chavan, S; Mischra, S. 2000. **Effect of maleic anhydride treatment on steam and water absorption of wood polymer composites prepared from wheat straw, cane bagasse, and teak wood sawdust using novolac as matrix**. Journal of Applied Polymer Science 77(13): 2963-2967.

4413 Raknes, E. 1969. **The gluing of teak**. FIRA Transl. Furn. Indian Research Association Stevenage 12, Transl. from Medd. Norak Tretekn Institute 19.

A study of the gluability of teak with various adhesives. Caesin glue gave poor results, but all the other glues gave excellent results provided that the gluing pressure was 2 kg/sq.cm.

4414 Rawat, B.S; Rajput, S.S; Pant, B.C. 1972. **A note on the working qualities of some Indian timbers**. Indian Forester 98(11): 669-676.

Describes test conditions for four woodworking operations like planing, boring, mortising and turning and tabulates and evaluates the behaviour in each test of *Tectona grandis* and other species with information on the incidence of defects.

4415 Reinsch, H.H. 1963. **Painting and repainting teak**. (German). Industrie Lackier Betrieb, Hannover 31: 77-78.

Recommends cleaning exuding extractives from the surface with a solvent, and the use of a suitable primer, on an alkyd or polyurethane basis.

4416 Sastrodimedjo, S; Widodo, A.C; Sumantri, I. 1974. **Relation between the wear on hand saws and the cross-section of *Tectona grandis* logs**. (Indonesian). Laporan, Lembaga Penelitian Hasil Hutan 4: 3p.

The daily wear on the saws showed a positive linear regression on the total cross-section that was cross-cut per day, but the latter accounted for only 16 percent of the variation in the wear.

4417 Seetharamu, L; Victor, V.J; George, J. 1974. **Resistance to sustained load of polyvinyl acetate dispersion-based adhesives. Part II**. IPIRI Journal 4(2): 81-83.

The change of failing load with time of double lap joints of teak slips glued with PVA adhesive was determined. The limit of sustained loading for at least seven days under the conditions of the test was established.

4418 Sekhar, A.C. 1955. **Working qualities of some Indian timbers**. Indian Forester 81(11): 724-732.

Describes the methods employed at the Forest Research institute, Dehra Dun, to determine working and finishing qualities of wood and gives the working qualities determined for timbers including teak.

4419 Sekhar, A.C; Gulati, A.S. 1972. **Suitability indices of Indian timbers for industrial and engineering uses**. Indian Forest Records, Timber Mechanics 2(1): 1-62.

Methods of evaluation for constructing suitability indices are surveyed, and indices of suitability for industrial and engineering purposes are presented for species including teak.

4420 Sekhar, A.C; Rana, R.S. 1956. **Nail and screw holding power of Indian timbers**. Indian Forest Records (Timber Mechanics) 1(5): 109-122.

Teak is one of the many species on which work done has been reported.

4421 Shukla, K.S; Gupta, S.B. 1983. **Finishing qualities of some Indian woods**. Indian Forester 109(2): 80-90.

Specimens of forty nine Indian timbers including teak were given five different surface filling treatments after initial sanding and before a final sanding and application of shellac varnish. Data are tabulated for each species showing general properties and percentage of gloss developed after each treatment. Treatments tested were two coats of shellac varnish, chalk powder paste, linseed oil, paste of animal glue and chalk powder, or paste of chalk powder followed by a coat of copal varnish.

4422 Shukla, K.S; Pandey, K.N; Pant, B.C; Badoni, S.P. 1990. **Carving behaviour of some Indian timbers - a quantitative approach**. Journal of the Indian Academy of Wood Science 21(2): 27-32.

Carving behaviour of timbers including *Tectona grandis* is studied and the results are presented.

4423 Shukla, N.K; Singh, K.R. 1987. **Nail and screw holding power of Indian timbers**. Journal of the Indian Academy of Wood Science 18(2): 57-68.

A review of work at the Indian Forest Research Institute, reporting and discussing the results of tests on 50 Indian timbers under different conditions. Composite nail/screw holding power and suitability indices with respect to teak as 100 is reported.

4424 Shyamasundar, K; Victor, V.J. 1972. **Nail holding power of plywood. Part II. Nail holding power of wood, plywood, particle board and hardboard**. IPIRI Journal 2(3/4): 94-99.

The nail-holding powers of solid wood, teak, plywood, particle board and oil-tempered hardboard were compared. At similar thickness, the nail-holding power of plywood is nearly twice that of the other materials.

4425 Singh, S.M. 1973. **The painting of wood**. Paintindia 23: 16-21.

The species judged to have good paint holding properties were *Dalbergia sissoo* and *Tectona grandis*.

4426 Sobukawa, T; Kanazawa, H. 1977. **Studies on the gluing of the wood articles. X. Gluing of the furniture parts with new adhesives**. (Japanese). Mokuzai Kogyo Wood Industry 32(10): 14-18.

In bonding tests with uncoated teak, good bondability was obtained with aqueous vinyl urethane resin (VUR) and resorcinol resin adhesives. The bond strength of teak bonded with VUR was increased by increasing the volume of crosslinking agent in the adhesive.

4427 Stefanov, B; Naidenova, T.S. 1975. **Some tree species from Vietnam having wood valuable for the Bulgarian woodworking industry**. (Bulgarian). Gorsko Stopanstvo 31(10/11): 39-43.

Gives brief notes on the wood of thirty nine species of N. Vietnamese hardwoods of interest for Bulgaria including teak, especially in the furniture industry.

4428 Takenami, K. 1964. **Studies on the discoloration of wood. (I) Sensitivities of various wood species for the dyeing effect with iron, and (II) with copper and chrome**. Journal of Japanese Wood Research Society 10(1): 22-35.

Tabulates data for five softwood and eleven hardwood species, heartwood and sapwood veneers of which were soaked in a one percent Fe solution or in distilled water before being pressed against an Iron plate.

4429 Wang, S.Y. 1981. **Studies on the dimensional stability and durability of the coated surface of some woods for furniture**. Experimental Forest, National Taiwan University, Technical Bulletin 128: 40p.

Five timber species were impregnated with PEG solutions of varying concentration, viz. *Anisoptera, Tectona grandis, Acacia confusa, Intsia* and *Sindora*. One group of specimens was tested under desorption conditions and absorption conditions for dimensional stability.

Go top

Thermal Properties

4430 **Good fuel wood**. Indian Forester 74(7), 1948: p279.

Teak with a calorific value of 4909 to 5042 is considered as a good fuel wood.

4431 Chembukulam, S.K; Dandge, A.S; Kovilur, N.L; Seshagiri, R.K; Vaidyeswaran, R. 1981. **Smokeless fuel from carbonized sawdust**. Industrial and Engineering Chemistry, Product Research and Development 20(4): 714-719.

Studied carbonization of teak sawdust in detail. The temperature required for producing a char suitable for use as a smokeless domestic fuel was 538 degree C.

4432 Dubey, Y.M; Jain, J.D; Gupta, S. 1999. **Studies on thermal conductivity of some Indian hardwoods**. Journal of the Timber Development Association of India 45(1/2): 33-38.

Thermal conductivity of eleven Indian wood species including teak along the tangential direction in oven-dry condition at four different mean temperatures were determined and a relationship between thermal conductivity and specific gravity and temperature has been established.

4433 Fuwape, J.A. 1993. **Charcoal and fuel value of agroforestry tree crops**. Agroforestry Systems 22(3): 175-179.

Charcoal was produced from eighteen samples of short rotation trees including *Tectona grandis* from an agroforestry plantation at the Federal University of Technology at Akure, Nigeria. Combustion related properties were determined in wood and charcoal of each species. The gross heat of combustion of wood and charcoal was also determined.

4434 Jentzsch, H. 1952. **Determination of the ignition and combustion properties of wood and other substances using the author's ignition method**. Holz als Roh-und Werkstoff 10(10): 385-390.

The method and details of test were described.

4435 Kandya, A.K. 1982. **Caloric content and energy dynamics in six tropical dry deciduous forest tree species**. Indian Journal of Forestry 5(3): 192-195.

Calorific content of various plant parts was determined. Data are tabulated showing calorific content in different parts and energy contents at time of harvest for *Tectona grandis* and other species.

4436 Keylwerth, R; Christoph, N. 1963. **Basic investigations of the thermal decomposition and ignition of wood**. Mitt. Dcut. Ges Holzforsch 50: 125-137.

Thermal analysis of blocks of untreated and fire proofed wood were carried out. Pyrolysis gas chromatograms of untreated and fire-proofed teak are given.

4437 Komarayati, S; Gusmailina; Hendra, D. 1997. **Manufacturing of activated charcoal from teakwood sawdust**. Buletin Penelitian Hutan 15(2): 94-100.

Studied the quality of activated charcoal from teak sawdust and the water quality after treatment with the activated charcoal.

4438 Krishna, S; Ramaswamy, S. 1931. **A note on the variation in the calorific values of sapwood and heartwood of some of the Indian fuel woods**. Indian Forester 57(3): 110-117.

Data is presented of the calorific values of some of the fuelwoods including teak. When organic deposits were removed from heart wood, calorific value is correspondingly lowered in the case of teak and value of heart wood for all species is generally far more than sapwood.

4439 Krishna, S; Ramaswamy, S. 1932. **Calorific value of some Indian woods**. Indian Forest Bulletin 79.

Calorific value of completely dried and ash free teak wood is 4,989 cal. for sapwood and 5535 cal. for heartwood.

4440 Pandey, C.N; Kamala, B.S; Jain, J.C. 1981. **Thermal conductivity of some wood species of Karnataka**. Journal of the Indian Academy of Wood Science 12(1): 23-25.

A linear relation was found between the thermal conductivity and density of specimens of teak and other species.

4441 Pandit, B.R; Jana, C.K. 2001. **Energy content and its calorific values of *Tectona grandis* in Dangs forest ecosystem**. Advances in Plant Sciences 14(1): 53-56.

The calorific values in the different parts of *Tectona grandis* was analysed by Bomb calorimeter. The highest calorific values and lowest were observed in branches during winter season and summer season respectively.

4442 Rao, T.L.N; Datar, D.S. 1954. **Activated charcoal from teak wood sawdust**. Proceedings of Indian Science Congress Association 41: p108.

4443 Rao, T.L.N; Datar, D.S. 1957. **Activated charcoal from groundnut hull. Part III Comparative study of activated carbon from groundnut hull and teakwood sawdust**. Journal of the Indian Chemical Society 20(2): 75-81.

Comparative studies have been made using zinc and ferrus chlorides as activators and effect of washing the carbons with alkali solutions.

4444 Rierink, A. 1938. **On the calorific values of 60 Netherlands - Indian wood species**. Korte Meded Boschbouw Proefsta 62; Tectona 31(6): 400-418.

Teak and conifers are reported to have high calorific value. No relation is found between calorific value of sapwood or heartwood but heartwood generally has slightly high calorific value and these values are compared for Java, Burma and Siam teak .

4445 Shida, S; Shibusawa, T; Hukushima, Y. 1991. **Utilization and evaluation of exterior wood II. Sensory warmth of the deck materials**. Journal of the Japan Wood Research Society 37(12): 1123-1128.

The sensory warmth of a foamed plastic and six wood species including teak used in exterior decks was estimated at 60 degree C and its relation to thermal conductivity, surface temperature and specific gravity was determined.

4446 Singh, P. 1911. **Note on calorimetric tests of some Indian woods**. Indian Forest Bulletin 1.

Gives air dry and calorific power of plantation grown and natural grown teak of Burma.

4447 Steinbeck, K; Wijesinghe, M.T.J.P. 1982. **Calorific values of twelve forest tree species growing in Sri Lanka**. Sri Lanka Forester 15(3/4): 136-138.

Calorific values were determined of twelve species including teak.

4448 Sylviani; Widiarti, A. 2001. **Determination of superior species for fuelwood**. Journal Sosial Ekonomi 2(2): 139-150.

Go top

Natural Durability

(See also 0590, 0924, 3056, 3068, 4101, 4537)

4449 **Planted v/s natural teak**. Indian Forester 7, 1882: 256-257.

A general discussion on the durability of naturally grown teak timber as compared with that of plantation origin.

4450 **Durability of teak**. Indian Forester 50(6), 1924: p339.

Reports tests on transverse strength of teak wood of 370 years old from Bijapur remain normal. Teak beams of 6th century of Ctesiphon are reported undecayed and teak ribs at Buddhist Daliya and Karli date back to B.C.

4451 **Durability of heartwood**. Report of Forest Products, Australia 1960/61, 1961: 19p.

Tests showed that the termite resistance of teak heartwood, is largely due to anthrones and anthra quinones containing a beta carbon side chain. Decay resistance is associated with a neutral extractive.

4452 **Natural durability of teak**. Report of Forest Products, Australia 1964/65, 1965: p39.

Tests of decay resistance on samples from 21 *Tectona grandis* seed trees in a teak breeding programme in Papua-New Guinea have shown a wide variation in size of non-durable core.

4453 Abdurachim, M.R.A. 1960. **Stake test in Indonesia-I**. Forest Research Institute, Bogor, Special Communication 15: 19p.

4454 Abdurachim, M.R.A. 1965. **The influence of tree age on the durability of teak (*Tectona grandis*)**. Laporan, Lembaga Penelition, Kehutanan, Bogor 98: 12p.

Results of graveyard tests show that durability increases with increasing age. Decay was responsible for the damage to 81 percent of the specimens and termites or termites plus decay for the rest. The relation of resistance to extractive content is discussed.

4455 Ahmad, M. 1991. **Natural resistance in teak clones to leaf skeletoniser, *Eutectona*** *machaeralis* **(Lepidoptera: Pyralidae) in south India**. Indian Journal of Forestry 14(3): 228-231.

Twenty clones of teak were evaluated for their relative natural resistance against the leaf skeletonizer, *Eutectona machaeralis*, in a clonal orchard in Kerala. In most of the resistant clones the leaves were harder with smoother surfaces.

4456 Arndt, U; Willeitner, H. 1969. **On the resistance behaviour of wood in natural weathering**. Holz als Roh-und Werkstoff 27(5): 179-188.

Weathering caused weight losses up to 10 percent and also changes in colour and in odour.

4457 Bakshi, B.K (et al). 1961. **A note on decay resistance of teak, shisham and khair**. Indian Forester 87(1): 40-41.

Samples of three species including teak were tested with agar cultures of four different fungi. *Tectona grandis* was found to be moderately resistant. The outer heartwood was relatively more decay-resistant than the inner in teak.

4458 Bakshi, B.K; Puri, Y.N; Singh, S. 1967. **Natural decay resistance of Indian timbers. I. Introduction and method. II. Decay resistance of sal (*Shorea robusta* Gaertn.) and teak (*Tectona grandis* Linn.f.)**. Indian Forester 93(5): 305-328.

Soil block methods for evaluation of natural decay resistance of timber under laboratory conditions are described in detail. Decay resistance was tested on samples of teak from outer and inner heartwood regions on the same radius. Variations in decay resistance appear to be correlated with age of trees, rate of growth and radial position of heartwood in the logs.

4459 Barnes, A.H. 1940. **Fallacies about fire resistance**. Wood 5: 267-269.

Results from a test of the relative combustibility of certain timbers including teak are presented.

4460 Bavendamm, W; Anuwongse, B. 1967. **On the decay resistance of wood species from Thailand**. (German). Holz als Roh-und Werkstoff 25(10): 392-393.

Kolle-flask tests were carried out on species including *Tectona grandis* for decay resistance. The test fungi were *Coniophora cerebella*, *Polystictus versicolor* and *Daedalea quercina*.

4461 Becker, G. 1961. **Testing and assessing the natural termite resistance of wood**. (German). Holz als Roh-und Werkstoff 19(7): 278-290.

Investigations were made on the natural resistance of the sapwood and heartwood of fourteen tropical hardwoods including teak from Indonesia. Teak is the most resistant Indonesian test species.

4462 Bhat, K.M; Florence, E.J.M. 2003. **Natural decay resistance of juvenile teak wood grown in high input plantations**. Holzforschung 57(5): 453-455.

A study is made to evaluate the natural decay resistance of five year old juvenile teak wood grown in a fertilised and irrigated stand based on accelerated laboratory testing against two white rot fungi. It is found that juvenile wood from high input plantations is less decay resistant than the wood of 13 year old trees and mature teak wood of forest plantations.

4463 Brandis, D. 1882. **Extraordinary durability of teak**. Indian Forester 7: p260.

Gives an account of teak plants used in Vithal Raj Swami temple in old city of Vijayanagar, Mysore which are now more than 500 years old without any signs of decay of wood.

4464 Brascamp, E.H.B. 1915. **Examination of the durability of teak wood**. Tectona 8: p160.

4465 Brooks, R.L; Adamson, A.M; Baker, R.E.D; Crowdy, S.H. 1941. **Durability tests on untreated timbers in Trinidad**. Caribbean Forester 2: 101-119.

In the graveyard tests, it is found that fungus attack was more responsible for damage than termites. There was a fairly close correlation between the relative susceptibilities of the various timbers to termite and fungal attack.

4466 Chaudhry, M.I; Malik, N.K; Arshad, M. 1978. **Natural resistance of various timbers to the attack of *Coptotermes heimi* (Wasm)**. Pakistan Journal of Forestry 28(2): 123-126.

Twelve common timber trees of Pakistan were tested for their resistance to *Coptotermes heimi*. Based on the longevity of workers and soldiers released on sawdust of these timbers, *Cedrus deodara* and *Tectona grandis* proved the most resistant species.

4467 Cheriyan, P.V; Cheriyan, C.J. 1978. **Observations on the natural durability of fifteen**

species of Indian timbers in Cochin harbour waters. Journal of the Timber Development Association of India 24(1): 25-29.

Three pieces of heartwood of each of fifteen species were suspended in iron frames below low tide. They were examined for durability after a period. Teak was found moderately long lived.

4468 Cheriyan, P.V; Cheriyan, C.J. 1980. **A report on the durability of some common Indian timbers treated with creosote: Fuel oil in Cochin harbour waters**. Indian Forester 106(6): 413-417.

Fifteen provenances of twelve species of timber including teak were treated with a 50:50 mixture of creosote: fuel oil and tested for durability. Most species showed resistance to borers especially teak, *Dipterocarpus indicus* and *Xylia xylocarpa*.

4469 Chung, D.H; Chen, S.S. 1983. **A study on the electrical resistance property in wood**. Forest Products Industries 2(3): 45-52.

The electrical resistance of wood from twelve species including *Tectona grandis* was measured and found to be linearly related to moisture content, with resistance decreasing as moisture content increased.

4470 Costa, E.W.B da; Rudman, P; Gay, F.J. 1958. **Investigations on the durability of *Tectona grandis***. Empire Forestry Review 37(3): 291-298.

Laboratory tests were made of resistance to decay and termite attack and extractive content of eighteen natural and plantation grown teak trees. Teak sapwood samples were less resistant than the heartwood. Investigations are made of reasons for this difference, as well as studies of the nature and toxicity of extractive materials in teak.

4471 Costa, E.W.B da; Rudman, P; Gay, F.J. 1960. **Relationship of growth factors to durability of teak**. FAO Teak Sub-Commission, New Delhi FAO/TSC 60: 12P.

Detailed study of durability of teak from sixteen trees of ages 14-180 years old were selected and tested against decay resistance. It is indicated that high growth rate is associated with low durability. The growth factors tested include distance from zone of pith, number of growth rings from pith, age of tree at felling, rate of growth sample zone and time elapsed since zone was transferred to heartwood.

4472 Costa, E.W.B da; Rudman, P; Gay, F.J. 1961. **Relationship of growth rate and related factors to durability in *Tectona grandis***. Empire Forestry Review 40(4): 308-319 [Pakistan Journal of Forestry 13(2), 1963: 216-220].

In a detailed study of radial variation in durability of teak wood and its relationship to growth factors, 16 trees, 14-180 years old, were selected and 1-13 heartwood zones from each tree were tested for resistance to decay by *Coniophora olivacea* and *Coriolus versicolor* by a sawdust decay technique.

4473 Dai, Z.R; Xie, X.Y; Huang, Z.Y. 1985. **Natural resistance of 22 timber species to *Coptotermes formosanus* Shiraki in a laboratory test**. Acta Entomologica Sinica 28(2): 238-240.

The natural resistance of the timber of twenty two tree species to the termite *Coptotermes formosanus* was determined in laboratory tests in Guangdong Province, China. The results showed that the most resistant species include *Tectona grandis*.

4474 Das, N.R; Chandola, L.P; Ramola, R.C. 1965. **Data on the natural durability of timber species**. Journal of Timber Development Association, India 11(2): 6-12.

Durability of *Tectona grandis* in Madhya Pradesh is reported. Heartwood of this timber is very refractory to treatment.

4475 Don Pedro, K.N. 1983. **Natural resistance of some Nigerian timber species to *Amitermes evuncifer* Silvestri (Isoptera)**. Revue de Zoologie Africaine 97(3): 647-652.

The natural resistance of four timber species in Nigeria to attack by *Amitermes evuncifer* was tested in the laboratory under choice and forced-feeding conditions and teak is found resistant to termite attack.

4476 Edwardes, S.M. 1923. **A note on the durability of Indian teak**. Indian Forester 49(3): 165-168.

Quoted instances of using teakwood for over 2,000 years and recommends use of teak for ship-building as exceptionally most suitable wood.

4477 Forest Products Research Laboratory, Australia. 1944. **Termite-proofing of timber for use in the tropics**. Forest Products Research Laboratory, Australia, Leaflet 38: 6p.

A brief account of the types and general habits of termites is given and discusses the proper construction of buildings in termite-infested areas, use of soil poisons, preservative treatment of timber, plywood and fibre or composition boards and the use of termite resistant woods.

4478 Gambetta, A; Orlandi, E. 1978. **Natural durability of some tropical woods to marine borers in the Tyrrhenian Sea**. (Italian). Contributi Scientifico Pratici per una Migliore Conoscenza ed Utilizzazione del Legno 22: 9-17.

The marine borer resistance of eighteen tropical woods including *Tectona grandis* was tested by exposure to marine borers. *Tectona grandis* is found moderately resistant.

4479 Grace, J.K; Yamamoto, R.T. 1994. **Natural resistance of Alaska-cedar, redwood, and teak to Formosan subterranean termites**. Forest Products Journal 44(3): 41-45.

The relative susceptibility of the species to Formosan subterranean termite, *Coptotermes formosanus* was evaluated in laboratory tests. The results indicated that these naturally durable woods compared favourably in termite resistance with preservative treated woods.

4480 Grohs, B.M; Kunz, B. 1998. **Study on the development of a potential biological wood preservative against mould growth with heartwood extracts as an example**. Holz als Roh-und Werkstoff 56(4): 217-220.

The antifungal activity of the heartwoods of different trees including teak against wood inhabiting moulds was tested. Beside the heartwoods their organic extracts exhibited antifungal effects.

4481 Hardy, E. 1942. **Woods for dye vats and chemical storage**. Text. Record 60(711): 35-37.

Teak is found resistant to alkalis. Factors affecting the resistance of wood to corrosive chemicals are discussed briefly.

4482 Jackson, W.F. 1955. **Natural durability of Java teak sleepers**. Malaysian Forester 8(3): 159-160.

Data on the durability of Java teak sleepers laid on Malayan Railways are tabulated with comparative data on *Balanocarpus heimii* sleepers. Teak proved markedly inferior to Chengal.

4483 Jain, A; Roychoudhury, N; Sharma, S; Bhargava, A; Pant, N.C. 1998. **Host plant resistance to insect pests in teak (*Tectona grandis* Linn.f.) with reference to biochemical parameters**. Indian Journal of Forestry 21(4): 285-289.

The teak leaf skeletonizer, *Eutectona machaeralis* and the teak defoliator, *Hyblaea puera* are the key insect pests of *Tectona grandis* in India, causing severe epidemic defoliation in all teak growing areas. Some clones of teak from ten Indian states growing at the National Teak Germ Plasm Bank, Maharashtra were evaluated for natural resistance against these pests. Foliar phosphorus, calcium and magnesium content were found significantly higher in the most resistant clone and lowest in the most susceptible clone.

4484 Jain, A; Roychoudhury, N; Bhargava, A. 2000. **Role of foliar protein and polyphenol and their relationship to clonal resistance in teak against the leaf skeletoniser, *Paliga machaeralis* Walker (Lepidoptera: Pyralidae)**. Journal of Tropical Forest Science 12(2): 221-226.

Leaf protein and polyphenol contents were estimated for selected resistant and susceptible clones of teak to the leaf skeletoniser, *Paliga machaeralis*. The protein and polyphenol contents of clonal leaves were proportional to the amount of leaf damage. A low ratio indicated higher resistance and vice versa.

4485 Jain, A; Singh, A.K; Banerjee, S.K; Shukla, P.K. 2002. **Chemical screening of different clones of *Tectona grandis* in relation to resistance against their key defoliators**. Indian Journal of Forestry 25(3/4): 254-273.

Clones of teak belonging to ten states of India were considered as experimental host plants to evaluate resistant teak clones. On the basis of data on leaf area consumed and foliar constituents, some resistant teak clones were identified.

4486 Karamohandani, K.P. 1955. **Table showing natural durability, treatability, availability, cost and uses of timber of Bombay State**. Journal of Timber Dryers' Preservation Association 1(1): 10-11.

Information on natural durability of heartwood, treatability, quantity available annually in tons, price per ton, uses of teak is given.

4487 Kumar, S. 1971 . **Causes of natural durability in timber**. Journal of Timber Development Association of India 17(2): 1-15.

Reference is made to heartwood extractives responsible for decay resistance in species including teak is given. The effects of anatomical structure and of the presence of nutrient materials in the wood on its durability are considered.

4488 Lely, W.G. 1941. **Fire-resisting doors**. Wood 6: 40-41.

The fire resisting qualities of teak are emphasized.

4489 Maheswarappa, V; Naik, S.T. 2002. **Reaction of different clones of teak (*Tectona grandis*) against rust caused by *Olivea tectonae***. Plant Pathology Newsletter 20: 14-17.

A study was undertaken in Uttara Kannada, Karnataka to identify the teak clones resistant to rust. Out of the twenty five clones evaluated, four clones were completely free from the disease. Biochemical analyses were carried out for phenols and sugars in selected clones that showed different degree of rust resistance.

4490 Meshram, P.B; Joshi, K.C; Sarkar, A.K. 1994. **Relative resistance of certain clones of *Tectona grandis* to teak leaf skeletonizer, *Eutectona machaeralis* Walk. (Lepidoptera: Pyralidae)**. Indian Forester 120(1): 58-61.

Selected clones of teak from ten Indian states for resistance to various pests and diseases, were raised in polybags at the Tropical Forest Research Institute, Madhya Pradesh. Fresh leaves of the clones were tested against larva of the teak skeletonizer, *Eutectona machaeralis*.

4491 Mishra, S.C. 1992. **Comparative natural resistance of different clones of *Tectona grandis* Linn.f. to teak skeletoniser *Eutectona machaeralis* Wlk. (Lepidoptera: Pyralidae)**. Indian Forester 118(4): 274-278.

Sixteen clones of teak maintained in the teak germplasm bank at New Forest, Dehra Dun were evaluated for their natural variation in susceptibility to fourth-instar larvae of *Eutectona machaeralis* in laboratory.

4492 Mukhtar, A. 1987. **Relative resistance of different clones of *Tectona grandis* to teak defoliator, *Hyblaea puera* Cram (Lepidoptera: Hyblaeidae) in south India**. Indian Forester 113(4): 281-286.

Teak clones from Tamil Nadu, Kerala and Andhra Pradesh were planted in the clonal teak orchards at the field station of the Southern Forest Research Station at Walayar, Kerala. Susceptibility to *H. puera* was measured and clones from Tamil Nadu are the least preferred.

4493 Nair, K.S.S; Kedharnath, S; Koshy, M.P; Sudheendrakumar, V.V; Mohanadas, K; Varma, R.V; Mathew, G. 1989. **Search for natural resistance to the insect pests, *Hyblaea puera* in teak**. KFRI Research Report 62: 32p. Kerala Forest Research Institute, Peechi.

A search was made in Kerala for teak clones resistant to attack by the defoliator, *Hyblaea puera*, by examining extensive areas of plantations, natural forests and seed orchards. Many isolated trees were found unattacked amid totally defoliated trees. Standard methods were developed for screening trees for defoliator resistance and an artificial diet was developed for laboratory rearing of *H. puera*.

4494 Nair, K.S.S; Sudheendrakumar, V.V; Mohanadas, K; Varma, R.V; Mathew, G; Koshy, M.P; Kedharnath, S. 1997. **Search for teak trees resistant to the defoliator, *Hyblaea puera* Cramer (Lepidoptera, Hyblaeidae)**. Ecology and Evolution of Plant Feeding Insects in Natural and Man-made Environments: 109-122. A. Raman, Ed. International Scientific Pub., New Delhi.

A search for teak trees resistant to attack from the defoliator, *Hyblaea puera* is made in Kerala, by surveying extensive areas of plantations, clonal seed orchards and natural forests, during periods of defoliator outbreak.

4495 Narayanamurti, D. 1962. **Further note on the electrical resistance of Indian timbers**. Paintindia 12(3): 15-18.

Gives resistance values of twenty four species including *Tectona grandis* at five different moisture contents.

4496 Narayanamurti, D; Gupta, R.C; Verma, G.M. 1962. **Influence of extractives on the setting of adhesives**. Holzforschung und Holzverwertung 14(5/6): 85-88.

Studies the effect of extractives from *Acacia catechu* and *Tectona grandis* on the gelation time and rigidity modulus of adhesives.

4497 Narayanamurti, D; Jain, N.C; George, J; Pant, H.C. 1963. **Fungus resistance of Rajasthan teak**. Research and Industry 8(4): 97-98.

The resistance of the low girth Rajasthan teak to brown rot and *Polystictus versicolor* was studied.

4498 Narayanamurti, D; Verma, G.M. 1963 . **The effect of size of timber specimens on their decay resistance**. (English; German). Holzforschung und Holzverwertung 15(2): 30-33.

Studies on the resistance of *Acacia catechu*, *Dalbergia sissoo* and *Tectona grandis* to *Polystictus versicolor* revealed a straight-line relationship between weight loss and area of specimen.

4499 Parihar, D.R. 1997. **Field evaluation of natural resistance of timber and fuel wood against termite attack**. Annals of Arid Zone 36(1): 61-64.

The resistance of timber wood including *Tectona grandis* and fuel wood species to termite attack was assessed.

4500 Parkes, W. 1864. **Durability of teak**. Minutes of the Proceedings, Institute of Civil Engineering, London 23: p39.

4501 Popham, F.J. 1932. **Durability tests on untreated Indian timbers**. Indian Forester 58(1): 9-19.

Gives results of tests of seventy nine Indian timbers including teak and an account of the procedure adopted.

4502 Prasad, B.N; Jain, N.C; Chelvarajan, B.K. 1964. **Observations on the durability of South Indian timbers in treated and untreated condition**. Indian Forester 90(1): 32-39.

Average life of *Tectona grandis* is reported as 84 to 119 months. The heartwood of *Tectona grandis* is very refractory to treatment.

4503 Premrasme, T. 1957. **The durability of teak**. Vanasarn 15(3): 23-28.

The durability of teak wood found at Mahatat monastery, Ayuthia is described, which king Ramesanan built in 1484 A.D. The teak wood are still in sound condition.

4504 Puri, Y.N. 1967. **Natural decay resistance of Indian timbers. III. Heartwood extractives of sal (*Shorea robusta* Gaertn.) and teak (*Tectona grandis* Linn.f.)**. Indian Forester 93(7): 447-454.

Samples of *Tectona grandis* and *Shorea robusta* were tested for decay resistance after treating with various solvents.

4505 Raveendran, T.V; Wagh, A.B. 1990. **Studies on the durability of twenty species of Andaman timbers in Goa waters**. Journal of the Indian Academy of Wood Science 21(2): 9-16.

Twenty species of timber including teak from the Andaman group of Islands were exposed in Goa harbour waters. The main marine borers were *Martesia striata* and *Lyrodus pedicellatus*. *Tectona grandis* is found very resistant.

4506 Roychoudhury, N. 2002. **Relative resistance in teak clones to leaf skeletonizer, *Eutectona machaeralis* (Walker) (Lepidoptera: Pyralidae) and role of leaf moisture**. Entomon 27(2): 211-214.

Fourteen clones of teak from Andhra Pradesh, Tamil Nadu, Orissa, Maharashtra and Uttar Pradesh were screened for relative resistance against the insect pest, *Eutectona machaeralis*. Water content of contributory leaves of teak clones revealed a gradual increase in relation to leaf area consumption.

4507 Roychoudhury, N; Bhowmik, A.K; Jain, A; Joshi, K.C; Banerjee, S.K. 1998. **Relative resistance in teak clones to *Spodoptera litura* (Fabricius) Boursin (Lepidoptera: Noctuidae), in relation to certain leaf nutrients**. Indian Journal of Forestry 21(4): 321-326.

The relative natural resistance to *Spodoptera litura* of teak clones was determined by field observations at Jabalpur, Maharashtra and feeding bioassays in laboratory. Leaves of the different clones showed a gradual increase in leaf water contents in relation to leaf consumption.

4508 Roychoudhury, N; Jain, A; Joshi, K.C. 1995. **Resistance in teak clones against leaf skeletonizer, *Eutectona machaeralis* Walker (Lepidoptera: Pyralidae)**. Advances in Forestry Research in India 13: 140-157.

The results are reported of laboratory and field evaluations of the resistance of clones of teak from ten states to *Eutectona machaeralis*. Tests in which leaf extracts of resistant clones were sprayed onto susceptible leaves, indicated the possibility that factors in the leaves determined feeding potential for the pest.

4509 Roychoudhury, N; Jain, A; Joshi, K.C; Lal, R.B. 1997. **Natural resistance in teak clones to leaf skeletonizer *Eutectona machaeralis* walker: An appraisal**. Indian Forester 123(11): 1027-1035.

Research on the natural resistance of teak clones against insect pest in India, *Eutectona machaeralis*, is described. Aspects discussed are mechanisms of natural resistance and their exploitation and clonal resistance -

including the identification and selection of resistant genotypes.

4510 Roychoudhury, N; Joshi, K.C. 1996. **Search for natural resistance in teak clones against *Eutectona machaeralis* Walker (Lepidoptera: Pyralidae)**. Indian Journal of Forestry 19(3): 205-213.

Clones of teak from ten Indian states were evaluated for possible natural resistance to the pest, *Eutectona machaeralis*. The study revealed that the clone from Orissa was the most resistant. The remaining clones were ranked as highly resistant, resistant, moderately resistant, least resistant, moderately susceptible, susceptible, highly susceptible and most susceptible.

4511 Rudman, P. 1958. **Relationship on tectoquinone to durability in *Tectona grandis***. Nature 181(4610): 721-722.

It is found in the laboratory that tectoquinone present in teak heartwood shows no sign of toxicity for wood destroying fungi, its effect on subterranean termites is slight and it is not solely responsible for the termite resistance of teak.

4512 Rudman, P. 1959. **Factors affecting the durability of teak**. Commonwealth Scientific and Industrial Research Organization, Australia, Forest Products Newsletter 253: 1-2.

4513 Rudman, P. 1961. **The causes of natural durability in timber. Pt. VII. The causes of decay resistance in teak (*Tectona grandis* Linn.f.)**. Holzforschung 15(5): 151-156.

The causes of decay resistance in teak heartwood were studied, paper chromatography and counter current distribution being used to fractionate the crude heartwood extractives, and the resulting fractions and pure compounds then tested for antifungal activity by measuring the rate of decay of impregnated sawdust.

4514 Rudman, P; Costa, E.W.B da. 1960. **Investigations on the durability of teak**. FAO Teak Sub-Commission, New-Delhi FAO/TSC.

Laboratory investigations on the durability of teak wood, chemical basis of decay and termite resistance of teak wood, relationship of durability to genetic and silvicultural factors, implications of the results in silvicultural practice, requirements for future work and establishment of tree breeding and silvicultural experiments are discussed.

4515 Rudman, P; Costa, E.W.B da; Gay, F.J. 1967. **Wood quality in plus trees of teak (*Tectona grandis* Linn.f.)**. Silvae Genetica 16(3): 102-105.

The teak improvement programme of the Papua and New Guinea Department of Forests includes the establishment of a seed orchard of second generation teak at Keravat in New Britain. Decay resistance was tested with *Coniophora olivacea* and *Coriolus versicolor* on wood specimens, while termite resistance was tested with laboratory colonies of *Coptotermes lacteus*.

4516 Rudman, P; Gay, F.J. 1961. **The causes of natural durability in timber. VI. Measurement of anti-termite properties of anthraquinones from *Tectona grandis* Linn. f. by a rapid semi-micromethod**. Holzforschung und Holzverwertung 15(4): 117-120.

A new rapid semi micro quantitative method has been developed for evaluating anti termite activity and its use is illustrated in the testing of four anthraquinones and two anthrones.

4517 Santhakumaran, L.N. 1969. **Preliminary observations on the relative resistance of selected species of Indian timber to gribble (Limnoria) attack**. Journal of the Bombay Natural History Society 66(1): 203-210.

Following an outbreak of damage by *Limnoria bombayensis* in Bombay harbour panels of twenty five species were exposed for 14 or 18 months. Panels of *Shorea robusta* and *Tectona grandis* were free from attack but other species were attacked.

4518 Santhakumaran, L.N. 1973. **On the natural resistance of *Lannea coromandelica*, *Tetrameles nudiflora* and *Tectona grandis* to marine borers in Bombay harbour**. Journal of the Timber Development Association of India 19(3): 26-30.

The nature and extent of damage to panels of the three timbers after 8.5 months' exposure are recorded. All the timbers showed good natural resistance to borers.

4519 Santhakumaran, L.N; Alikunhi, K.H. 1983. **Natural resistance of different species of Indian timbers to marine wood borers in Bombay waters**. Indian Forest Bulletin 272; Wood Preservation, Controller of Publication, New Delhi: 46p.

4520 Santhakumarn, L.N. 1986. **Further studies on the natural durability of Indian timbers in Goa waters against marine wood borers**.

Proceedings of the National Academical Science, India 56(B), II: 133-138.

4521 Savard, J; Andre, A.M; Guinet, P. 1960. **The resistance of tropical timbers to mineral acids**. (French). Bois For. Trop 74: 25-34.

In an attempt to classify some tropical hardwoods according to their resistance to HCl, HNO_3, and H_2SO_4, test pieces were soaked under conditions similar to those in industrial use and measurements were made of their absorption rate, weight loss and dimensional variability.

4522 Schultz-Dewitz, C. 1960. **Termite resistance tests on seven exotics**. (German). Holz Zentralblatt 86(99): p1379.

In tests with small specimens of 25-30 percent moisture content buried in soil and exposed to *Reticulitermes lucifugus* for four weeks. Teak from Indonesia and Siam had weight looses of only 1-3.3 percent and all termites died.

4523 Sen Sarma, P.K. 1963. **Studies on the natural resistance of timbers to termites**. Indian Forest Bulletin (n.s.) Entomology 220: 10p.

Out of forty Indian timbers tested, the most resistant species identified include *Tectona grandis*.

4524 Sen Sarma, P.K; Chatterjee, P.N. 1968. **Studies on the natural resistance of timbers to termite attack. V. Laboratory evaluation of the resistance of three species of Indian wood to *Microcerotermes beesoni* Snyder (Termitidae: Amitermitinae)**. Indian Forester 94(9): 694-704.

Wood sampling techniques, culturing of termites and testing of wood resistance to termites are described in detail. *Tectona grandis* is classed as very resistant.

4525 Sen Sarma, P.K; Thakur, M.L. 1979. **Relative termite resistance of heartwood of teak trees from known seed sources**. Holzforschung und Holzverwertung 31(1): 14-16.

Laboratory studies were carried out in India to determine the resistance to *Microcerotermes beesoni* of 400 samples of heartwood taken from teak trees and to ascertain whether resistance was controlled by herditary or environmental factors. The results indicated that seed source played a greater role than environmental factors.

4526 Southwell, C.R; Bultman, J.D. 1971. **Marine borer resistance of untreated woods over long periods of immersion in tropical waters**. Biotropica 3(1): 81-107.

Wood from 115 species was exposed to the three principal classes of borer in underwater sites in the Panama Canal Zone. Data are tabulated showing degree of damage to each wood species. Some woods including teak were resistant to borers.

4527 Supriana, N. 1988. **Studies on the natural durability of tropical timbers to termite attack**. International Biodeterioration 24(4/5): 337-341.

Small samples of tropical timbers were tested against the dry wood termite, *Cryptotermes cynocephalus* and the subterranean termite *Coptotermes curvignathus*. Four species including teak were found completely durable against both termites.

4528 Supriana, N; Howse, P.E. 1982. **Termite resistance of twenty eight Indonesian timbers**. International Research Group on Wood Preservation, Working Group I, Biological Problems. Document IRG-WP-1150: 14p.

Samples of species including teak were tested for resistance to the dry wood termite, *Cryptotermes cynocephalus* and the subterranean termite, *Coptotermes curvignathus*. *Tectona grandis* is found completely resistant to both species of termites.

4529 Tewari, M.C; Pant, S.C. 1974. **Natural durability by accelerated field trials of natural and plantation grown teak**. Journal of the Timber Development Association of India 20(2): 1-2.

The results of observations on the extent of termite attack on specimens of teak heartwood exposed to eighteen years at four sites in India and Burma are given. No significant difference was found between the average life of specimens prepared from plantation grown and natural grown teak.

4530 Torres, L; Silverborg, S.B. 1972. **Study on the natural durability of teak by means of accelerated soil/block tests in the National Forest Products Laboratory, Merida, Venezuela**. Boletin, Instituto Forestal Latino Americano 41-42: 63-70.

The fungus *Ustulina deusta* has been identified attacking the base of teak trees in a plantation in Venezuela, and causing the death of some trees. Soil/block tests were made to determine the resistance of sapwood and heartwood of teak to *U. deusta* and *Polyporus versicolor* and *Lenzites trabea*.

4531 Wolcott, G.N. 1946. **Factors in the natural resistance of woods to termite attack**. Caribbean Forester 7(3): 121-134; 139-149.

The most effective of the quinones tested are tectoquinone, which is presented in large amounts in East Indian teak to account for its well known resistance to termites.

4532 Yoshimura, M. 1962. **Decay resistance of several tropical and U.P. woods extracted with hot water to *Polyporus versicolor* and *Poria monticola***. (Japanese; English). Bulletin of Faculty of Agriculture, Mie Daigaku Noyakubu University 26: 143-170.

Wafers extracted in hot water and exposed to *Polyporus monticola*, showed correlation between weight loss and moisture content. In extracted specimens special grade was more related to resistance than in controls.

4533 Yoshimura, M. 1962. **The effect of hot water extractives - several tropical and U.S. woods on the growth of *Polyporus versicolor* and *Poria monticola***. (Japanese). Bulletin of Faculty of Agriculture, Mie Daigaku Noyakubu University 25: 99-122.

The effect of the extractives from 10 tropical species including teak varied greatly between species and test fungi, and there was no close correlation between toxicity of the extractive and the durability of the wood.

4534 Yoshimura, M. 1963. **Effect of extractives upon decay resistance of wood**. (Japanese; English). Mie Daigaku Nogakubu Gakujutsu Hokoku 27: 225-325.

The effect of different extractives and fungal species and decay resistance of various woods is studied and extraction by Et2O diminished decay resistance of teak. The weight loss due to the decay was proportional to the amount of extracted material and also to the reduction in specific gravity.

Go top

Preservative Treatments

4535 **Air seasoning-girdled trees and log seasoning**. Forest Research in India and Burma 1945-46, Part I, 1947: 43-45.

After four months of extraction, teak logs are floating with 1/4 of volume above water. When girdled and kept of three years drying logs in greater than other species.

4536 **Seasoning of girdled trees**. For. Res. India Burma 1945-6, Pt. 1, 1947: 44-45.

A set of girdled trees of *Tectona grandis*, *Xylia xylocarpa*, *Hopea parviflora* and *Ougeinia dalbergioides* were felled after having been kept girdled for three years. Drying was found greater in teak than in other logs and longitudinal cracks in them were attacked by borers.

4537 Alliot, H. 1947. **The protection of timber against termites**. Les techniques du bois 2: 138-140.

The preservatives used in the tests were creosote, pentachlorophenol, DDT, and hexa-chloro-cyclo-hexane. Tests were also made for natural resistance to termite attack. The most resistant species include *Tectona grandis*.

4538 Barber, H. 1940. **Air drying tests on Burma timbers being a record of observations made during the period 1925 to 1936**. Burma Forest Bulletin 33(8): 70p.

A record of drying observations for fifty species including teak indicated division of the species into very refractory, moderately refractory and non-refractory and teak is considered moderately refractory.

4539 Barnacle, J.E; Ampong, F.F.K. 1974. **Refractory intermediate wood in round teak fence posts**. Ghana Journal of Science 14(2): 193-198.

Preservative problems associated with the occurrence of a relatively wide zone of intermediate wood virtually impermeable to treatment in fence posts cut from unpruned plantation grown *Tectona grandis* trees and alternating penetrated and non penetrated bands of heartwood in some preservative treated small fence posts.

4540 Encinas, O; Contreras, W. 1998. **The use of teak (*Tectona grandis* Linn.f.) preserved with CCA as an alternative construction material for Venezuelan housing**. (Spanish). Revista Forestal Venezolana 42(2): 113-118.

Traditional folk practices are used in Venezuela to prolong the service life of small diameter thinnings of teak used in construction of low cost housing. A case study is described where thinnings treated with CCA were used to construct a house in a small town.

4541 Forest Research Institute, Dehra Dun. 1939. **Notes on teak from annual report**. Forest Administration Report, Forest Department, Bombay 1937/38. Forest Research Institute, Dehra Dun.

A wood preservative known as Cuprex prevented the decay of teak buried 1 ft. underground for one year.

4542 Kapoor, S.N. 1934. **Manual of air seasoning of Indian timbers 1934**. Forest Research Institute, Dehra Dun.

Gives air seasoning characteristics of various species including teak.

4543 Kapoor, S.N. 1939. **A manual of the air seasoning of Indian timbers 1939**. Forest Research Institute, Dehra Dun: 80-90.

Seasoning characteristics of teak timber are given on page 80-90.

4544 Kapoor, S.N; Rehman, M.A. 1939. **Notes on the air seasoning characteristics of some Indian woods**. Indian Forest Records (n.s.) Utilisation 8: 230p.

4545 Keylwerth, R; Gaiser, H; Meichsner, H. 1955. **Investigations on a seasoning plant operating with superheated steam**. (German). Holz als Roh-und Werkstoff 13(1): 5-20.

The temperature field, drying process, drying time and power consumption, as well as the distribution of air velocity, were studied in a Benno Schilde superheated steam drier of trimmed sawn timber. Both the temperature and air current fields were found to be very advantageous for seasoning purposes. Air dry broadleaved woods which include teak were seasoned at 110-127 degree.

4546 Knight, R.A.G; Armstrong, F.H. 1938. **Kiln-seasoning treatments of teak and their effects on its wearing qualities as flooring**. D.S.I.R., Forest Products Research Records 23: 14p .

An account is given of six kiln seasoning experiments on teak strips and of the effect on the floor wearing qualities of the material of kiln treatments. It is concluded that the principal factor influencing the choice of drying schedule is the characteristic variation of moisture content.

4547 Latif, M.A; Younus-uzzaman, M; De, B.C. 1981. **Pressure treatment of teak poles with oil borne preservative**. Bano Biggyan Patrika 10(1/2): 27-32.

Poles were treated with 40:60 creosote/light diesel oil by the Bethel full-cell process. The effects of varying pressures and treatment periods were evaluated on penetration and retention of the preservative.

4548 Lee, J.S; Sakuno, T; Ohsaki, T. 1990 . **The decay resistance of stain treated wood**. Research Bulletin of the Tottori University Forests 20: 39-46.

Results of accelerated decay resistance tests and anti mould tests given for veneer samples of teak treated with oil stain.

4549 Lin, R.J; Liao, K.F; Peng, S.F; Hong, K.J. 1998. **Studies of basic property of wood by sand heat treatments. (I) The effect of treating temperature on dimensional stability of wood**. Forest Products Industries 17(1): 21-35.

A study was made to modify the dimensional stability, colour change and specific gravity of wood which include teak, by heat treatment at different temperatures by sand heating. The reduction in specific gravity increased with the increasing temperature of the treatment, but it was inversely correlated with the specific gravity of the wood.

4550 Maden, M; King, B; Gulati, N; Kaur, K; Khosla, P.K. 1982. **Total nitrogen balances in some preserved and unpreserved Indian woods**. Symposium Proceedings: Improvement of forest biomass: 429-434. Indian Society of Tree Scientists, H.P. Agricultural University, Solan.

The relations between nitrogen content of wood including teak in soil contact and fungal colonization and decay are discussed.

4551 Martawijaya, A. 1988. **Discoloration of teak wood due to kiln drying**. Duta Rimba 14(101/102): 3-10 (In); 11-16 (En).

Possible factors influencing the discoloration of teak during kiln drying are discussed. The factors include kiln temperature and humidity and the surface accumulation and oxidation of wood extractives.

4552 Nussbaum, R.M. 1993. **Oxidative activation of wood surfaces by flame treatment**. Wood Science and Technology 27(3): 183-193.

Veneers of teak, pine and birch were oxidized by flame treatment. Wettability was increased and microbiological activity was reduced by the sterilizing effect of the treatment. Electron spectroscopy for chemical analysis measurements showed an increase in oxidation level as a result of the flame treatment.

4553 Pearson, R.S. 1919. **Experiment carried out to determine the contraction across the grain which takes place in teak: (*Tectona grandis*) while seasoning**. Indian Forester 45(9): 462-464.

4554 Purushotham, A (et al). 1958. **Preliminary note on the high pressure treatment of timber with wood preservatives**. Journal of Timber Dryers' Preservation Association 4(2): 29-34.

Tectona grandis is one of the species dealth with.

4555 Purushotham, A; Vidyasagar. 1956. **Note on the treatment of timber poles by the Boucherie process**. Journal of Timber Dryers' Preservation Association 2(2): 14-16.

Tectona grandis is one of the species dealt with.

4556 Ranganathan, S.K; Aziz, M.A; Koshi, T; Sankaran, V. 1949. **Studies in contact toxicity. Part II. Reactivation of surface treated with dichloro diphenyl trichloroethane (DDT) by storage in a Burma teak box**. Indian Academy of Sciences Proceedings 30B(3): 176-184.

The toxicity of glass surfaces treated with DDT, exhibiting only feeble activity against *Culex fatigans*, was found to be renewed after storage in a Burma teak box. Storage in boxes of species including teak had no effect on the toxicity.

4557 Reddy, G.V.N; Reddy, M.R. 1985. **Effect of chemical treatment or pelleting of saw dust on chemical composition and in vitro digestibility**. Indian Journal of Animal Nutrition 2(4): 171-174.

Effect of teak sawdust treated with H_2O_2, H_2SO_4, NaOH, NH_3 and steam pelleting on chemical composition is studied. Pelleting and H_2O_2 treatment had little effect on composition and digestibility of sawdust.

4558 Rehman, M.A. 1939. **The seasoning behaviour of Indian timbers**. Indian Forest Bulletin (n.s.) Wood Seasoning 170.

4559 Rehman, M.A. 1943. **Air condenser kiln suitable for the seasoning of cooperage woods and packing case timbers**. Indian Forest Leaflet (Utilisation) 43: 6p.

A description is given of a natural draft furnace heated kiln designed primarily for the seasoning of cooperage woods and packing case timbers including teak.

4560 Rehman, M.A. 1955. **Seasoning behaviour of Indian timbers Part II (Kiln drying schedules)**. Indian Forester 79(7): 369-375.

Teak is included in kiln drying schedule V. The tentative schedule for 1 inch thick planks of *Tectona grandis* is given. Teak timber will take 13-16 days to season. In addition to the initial steaming, the timber may need two intermediate and one final steaming at 55 degree C/100 percent R.H. for 2-4 hours.

4561 Sales, C. 1979. **Some seasoning times**. (French). Bois et Forests des Tropiques 186: 52-53.

A list of twenty three tropical species including teak, giving the seasoning times necessary to bring pieces of wood of various thickness to an average moisture content of 12 percent.

4562 Samapudhi, K. 1954. **The rate of drying of teak logs**. (Siam; English). Vanasarn 12(1): 63-68.

Logs cut green and stored, unbarked, in a well ventilated room had dried to constant weight within 18 months.

4563 Santhakumaran, L.N; Krishnan, R.V. 1991. **Resistance of six timber species treated with CCA and CCB, against marine borer attack in Goa waters**. The International Research Group on Wood Preservation, Stockholm IRG/WP/4166: 1-14.

Included teak.

4564 Sattar, M.A. 1987. **Comparative studies of wood seasoning with a special reference to solar drying**. Bano Biggyan Patrika 16(1/2): 30-42.

Data are reported of drying studies with twenty species including teak in Bangladesh, using solar drying, conventional air drying and steam heated kiln drying.

4565 Sattar, M.A; Talukdar, Y.A; Ali, M.O. 1973. **Studies on dimensional stability and variation in moisture content of kiln dried wood samples of ten indigenous species of Bangladesh**. Bano Biggyan Patrika 5(2): 1-20.

Sawn samples were prepared from kiln-dried lumber of each of ten tree species including teak, one set was suspended in an open shed, while the other was placed in-doors. Measurements were made at monthly intervals of changes in weight and structural dimensions over a 17-month period. The smallest dimensional changes occurred in samples of *Tectona grandis*.

4566 Selaphat, J. 1968. **Effect of heat treatment on static bending of teak**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The static bending property when heated at 150 degree C increases upto three hour period and later on for next three hours it decreases. At 200 degree C the static bending property go down with time of heating.

4567 Seneviratne, E.W. 1981. **Results of seasoning trials with some local timbers**. Sri Lanka Forester 15(1/2): 30-33.

Results are given of air seasoning and kiln seasoning trials with species including teak from Sri Lanka.

4568 Videlov, K.H; Ullevalseter, R.O. 1974. **Investigation on the work of a lumber kiln using the condensation effect**. (Bulgarian). D'r-voobrabotvashcha i Mebelna Promishlenost 17(6): 7-14.

Describes the dehumidification kiln developed in Norway and gives the results of drying trials with teak lumber and different initial moisture content.

4569 Wu, H.T; Lin, J.S. 1997. **Study on the kiln drying of teak, India-charcoal trema, *Formosan alder* and schefflera tree 3-cm thick lumber**. Bulletin of National Pingtung Polytechnic Institute 6(1): 41-48.

Four species of lumber including teak were dried with high temperature drying, conventional kiln drying and conventional high temperature drying. Drying with high temperature drying could reduce drying time by about 57 percent and energy consumption was reduced by about 38 percent compared with conventional kiln drying.

4570 Yoneta, M; Mamun, J. 1996 . **Kiln drying test of three papua new guinea woods**. Journal of the Hokkaido Forest Products Research Institute 10(2): 14-21.

The present study aims to find out an optimum schedule for drying Papua New Guinea plantation and lesser used wood species including teak in a kiln. The following three tests were performed, quick drying tests at 100 degree C, tests of drying rates at 60 degree C, and tests of drying schedules with boards of commercial sizes.

Go top

Wood Grading

4571 **Grading of Indonesian teak**. Proceedings of the Technical Meeting on Standardization of Nomenclature, Terminology, Testing Methods, Grading and Dimensions of Timber, Dalat, Vietnam, 1950 F50/FE/14, 1950: 6p.

Rules for export squares, export flitches and sleepers.

4572 **Timber grading in Thailand**. Proceedings of the F.A.O. Technical Meeting on Standardization of Nomenclature, Terminology, Testing Methods, Grading and Dimensions of Timber, Dalat, Vietnam, 1950, No. F50/FE/16, 1950: 7p.

Manufacturers' lumber grading rules, chiefly for teak.

4573 **Asia-Pacific regional grading rules for teak-logs**. Asia-Pacific Forestry Commission, 1959: 52p.

4574 **Indian railway standard specification for hardwood logs**. RDSO K1-65, Lucknow, 1965.

4575 **Specification of structural timber in buildings**. BIS, New Delhi, 1986.

4576 **Grading rule of teak wood in Perum Perhutani**. Proceedings of the 3rd Regional Seminar on Teak, Yogyakarta, Indonesia, 2000: 2-4.

4577 Balasundaran, M; Gnanaharan, R. 1997. **Timber defects of plantation grown teak and their implication on wood quality**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 129-134. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Research Institute, Peechi.

A survey was made of common timber defects of teak raised in plantations. The most serious defects were fire marks, rind galls, occluded branches and occluded wounds. Prevention of fire and proper and timely thinning of the teak plantations are suggested to reduce erosion in timber quality.

4578 Bhat, K.M. 2000. **Technology packages for quality wood products of teak plantations: Challenges and promises for the 21st century**. Group Session of 21th IUFRO World Conferences, Kuala Lumpur, Malaysia 5.06402.

4579 Chew L.T. 2003. **Malaysia's experience in timber certification**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

MTCC is an independent organisation established to operate a voluntary national timber certification scheme in Malaysia. The external and internal challenges faced by MTCC in implementing the certification scheme, as well as the main impacts of the scheme are highlighted.

4580 FAO. 1955. **Standard grading for imported teak (squares and sawn-lumber) Japan**. FAO/Asia-Pacific Forestry Commission, Tokyo FAO/APFC-55/64: 11p.

4581 FAO. 1956. **Draft South East Asia grading rules for teak conversion**. FAO Teak Sub-Commission, Bangkok FAO/TSC-56/11: 5p.

4582 FAO. 1956. **Draft South East Asia grading rules for teak squares**. FAO Teak Sub-Commission, Bangkok FAO/TSC-56/13: 12p.

4583 FAO. 1956. **Draft South East Asia grading rules for teak-logs**. FAO Teak Sub-Commission, Bangkok FAO/TSC-56/14: 16p.

4584 FAO. 1957. **Comments on the FAO draft teak grading rules (logs, squares and conversions) by the timber trade federation of the United Kingdom**. FAO Teak Sub-Commission, Bangkok FAO/TSC-57/16: 12p.

4585 FAO. 1957. **Final draft for S.E.A. grading rules for teak squares**. FAO Teak Sub-Commission, Bangkok FAO/TSC-57/12: 12p.

4586 FAO. 1957. **Final draft S.E.A. grading rules for teak-logs**. FAO Teak Sub-Commission, Bangkok FAO/TSC-57/14.

4587 FAO. 1957. **Final draft S.E.A. grading rules for teak conversions**. FAO Teak Sub-Commission, Bangkok FAO/TSC-57/15: 11p.

4588 FAO. 1958. **Asia-Pacific regional grading rules for teak squares**. FAO, Rome FAO/TSC-57 B Rev. 1: 26p.

These rules, approved at the Second Session of the Teak Sub-Committee at Bandung in 1957, are based largely on the Seaman-Limaye Rules of 1936.

4589 FAO. 1960. **Report of the ad hoc committee on teak grading**. FAO Teak Sub-Commission, New Delhi FAO/TSC-60/6/4: 3p.

Recommendations are made on further study and observations for teak grading teak squares, teak logs and teak conversions are made.

4590 FAO. 1960. **Report of the study group on teak grading**. FAO Teak Sub-Commission, New Delhi FAO/TSC-60/6/1: 1p.

Report of the study group on teak grading with draft rules for teak squares, teak logs and teak conversions presented for consideration and incorporation.

4591 FAO. 1962. **Draft Asia-Pacific grading rules for teak conversion other than squares**. FAO/Asia-Pacific Forestry Commission: 7p.

4592 Forest Department, Burma. 1939. **The valuation of round teak logs**. Forest Department, Rangoon, Burma: 22p.

4593 Gallant, M.N. 1939. **Classification of teak logs**. FRI, India: 28p.

4594 Gresser, E. 1932. **Notes on the knotty variety of teak**. (Dutch; English). Tectona 25: 269-272.

4595 Indian Standards Institute, New Delhi. 1963. **Classification of commercial timbers and their Zonal distribution (revised) IS: 399**. Indian Standards Institute, New Delhi .

Gives the following information on *Tectona grandis*. Its average weight, durability-high treatability heartwood only partially treatable, refractoriness to air seasoning.

4596 Indian Standards Institution, New Delhi. 1966. **Indian standard grading rules for teak squares**. Indian Standard IS 3731: 11p. Indian Standards Institution, New Delhi.

Covers the requirements for various grades of *Tectona grandis* squared logs based on defects.

4597 Indian Standards Institute, New Delhi. 1985. **Grading rules for teak logs**. Indian Standard 33641-1985. Indian Standards Institution, New Delhi.

4598 Karsoedjono; Tedjokoesoemo, R.H. 1956. **Teak grading rules (Indonesia)**. FAO Teak Sub-Commission, Bangkok FAO/TSC/56/24.

4599 Limaye, V.D. 1952. **The timber grading school at Singapore**. Indian Forester 78: p252.

Lists the subjects on theory of teak grading on which lectures were delivered at International timber grading school at Kepong in Malaya.

4600 Limaye, V.D. 1957. **Grouping of Indian timbers and their properties, uses and suitability**. Indian Forest Records (n.s.) Timber Mechanics 1(2): 19-64.

Grouping of timbers according to their suitability values for each property, properties and uses of each timber species, the average weight and the observed maximum and minimum weights of each species and charts showing the suitability of species by means of stick-diagrams.

4601 Menon, K.D. 1979. **Grading and standardization in major timber producing countries in the South East Asian region**. Economic Commission for Europe, Timber Committee: Seminar on the utilization of tropical hardwoods, Amsterdam (Netherlands), 15-18 May 1979, TIM-SEM.8-R.12: 8p.

Regulations and current procedures are described for grading of teak and non-teak hardwood logs and sawn timber, teak squares and plywood in Burma, Indonesia, Malaysia, Philippines and Thailand.

4602 Rajput, S.S; Gulati, A.S. 1983. **A note on the classification of timbers for doors and windows**. Journal of the Timber Development Association of India 29(1): 13-20.

It is suggested that timbers should be classified according to a strength factor, which is calculated from weight relative to teak, strength as a beam, suitability as a post or strut, splitting coefficient, nail/screw holding properties and retention of shape.

4603 Rajput, S.S; Gulati, A.S. 1983. **Some considerations on the selection of reference timber for comparison in the evaluation of suitability indices of Indian timbers**. Journal of the Indian Academy of Wood Science 14(2): 96-102.

Data are tabulated and analysed for fourteen samples of teak from different locations in India and an average Indian teak was derived and the physical and mechanical properties and suitability indices for nine purposes are given for this average teak which will serve as the revised reference timber.

4604 Ranatunga, M.S. 1979. **Timber grading and scaling**. Sri Lanka Forester 14(1/2): 67-69.

A brief introductory survey is given of the rules followed in Malaysia, Indonesia, Philippines and Burma, with particular reference to log grading.

4605 Rao, K.S. 2003. **Certification and labelling of wood products with special reference to opportunities and problems for teak in India**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

An attempt is made to examine the opportunities, constraints and apprehensions concerning timber certification and its labelling in India with special reference to teak.

4606 Royal Forest Department, Bangkok. 1964. **Proposed grading rules for teak veneer logs**. Royal Forest Department, Bangkok: 1-6. Forest Department, Thailand.

The defects are defined and illustrated.

4607 Seaman, I.N; Limaye, V.D. 1935. **Rules for the grading of teak squares**. Government of India Publication: 19p.

4608 Sekhar, A.C; Sharma, R.S. 1967. **Practical application of shrinkage values in grading of timber**. Indian Forester 93(2): 98-106.

Derives formulae for the calculation of radial and tangential shrinkage values of timber dried from green to oven dry and green to twelve percent moisture content.

4609 Sriklam, I. 1961. **Teak classification Keen's method**. (Thai). Student Thesis. Kasetsart University, Bangkok.

Teak was classified by this method into four diameter class with 30-50 cm, 50-70 cm, 70-100 cm and over 100 cm and in each class trees were classified into, best, moderate and poor.

4610 State Timber Board, Burma. 1963. **Grading rules for teak veneer logs**. State Timber Board, Burma: 11p.

Gives definitions, system of grading, general requirements etc. and the rules are illustrated with figures and the allowances shown for various defects is given in a schedule of grading rules for teak veneer logs.

4611 Trockenbrodt, M; Josue, J. 1999. **Wood properties and utilisation potential of plantation teak (*Tectona grandis*) in Malaysia - a critical review**. Journal of Tropical Forest Products 5(1): 58-70.

Shows that the most technological properties of the timber produced in plantations will not differ significantly from mature plantation teak or naturally grown teak. The only differences are in the natural durability and the frequency of defects such as knots and shakes. The main limiting factors for young plantation teak are the comparatively small stem diameter at breast height and hence the smaller diameter of the heartwood at breast height.

4612 Tze, W.T.Y. 1999. **Recovery and quality of lumber from mature teak (*Tectona grandis*) planted in Sabah, Malaysia**. Journal of Tropical Forest Products 5(2): 115-123.

A study was made to determine the graded lumber recovery of teak logs and to examine the related natural defects of the timber. The results of this study can be used to visualize the minimum yield and quality of the lumber to be expected. The data can be useful for both considerations of commercial teak planting and management of lumber production.

4613 Warta, A.J. 1926. **Classification and sizes of teak exported from Java**. Tectona 19: 848-854.

The specification of teak exported from Jave to Europe are given and compared with those applied to the same timber from British India, and Siam for the markets of Europe and North America.

4614 Wehlburg, A.F. 1910. **Classification of teak at the growing area**. Tectona 2(1): 1-14.

Go top

Wood Utilisation

4615 **Teak wood**. Indian Forester 41(12), 1915: 503-504.

Gives an account of various uses to which teak timber was put in Europe.

4616 **Teak timber recommended for carriage and wagon building**. Timber Dryers' Preservations Association 2(3), 1956: 15p.

Teak timber recommended for the construction of various parts of passenger coaches is listed.

4617 Arief, S.M. 1953. **Investigations on the weight of firewood**. (Javanese). Rimba Indonesia 2(10/12): 413-423. (Communication of Forest Research Institute, Bogor Bo. 41, 1953).

The average weights obtained differed from those for 1921 and 1922), probably because of differences in measurements of the assortments and in the length of time between felling and measurement.

4618 Brascamp, E.H.B. 1916. **Was the tower of Babel of teakwood?** Tectona 9: p894.

It has been discovered that Indian teak was used in the building of the temples of Babylonia.

4619 Brascamp, E.H.B. 1918. **The discovery of teak woods of Oangasana in 1727 in the Colonial Archief No.VIII**. (Indonesian; English). Tectona 11: 723-743.

4620 Brascamp, E.H.B. 1919. **About the teak woods of Damasces in 1772 in Kolonial Archief No. XII**. Tectona 12: 445-460.

4621 Carapiett, J.B. 1960. **Notes on ornamental timbers of Burma**. Burmese Forester 10(1): 37-53.

Gives notes on distribution, wood properties, and uses of teak and other species.

4622 Chaves, E; Fonseca, W. 1991. **Teak (*Tectona grandis* Linn.f.) tree of multiple use in Central America**. Turrialba: p60.

4623 Classen, J.C van R. 1908. **Notes on teak**. (Indonesian; English). Tectona 1: 163-169.

4624 Contreras Miranda, W; Contreras, M.O de. 2000. **Mucunutan I - structure housing prototype for Venezuelan Andes highland rural modern houses using timber and alternative constructive technologies**. (Spanish). Revista Forestal Venezolana 44(2): 53-61.

The structure was developed using small diameter, rounded and CCA preserved teak. The feasibility of architectural and structural design was demonstrated.

4625 De Patel, K.V. 1953. **Wooden posts for telecommunication lines**. Telecommunications, Jabalpur 3(1): 13-16.

Describes the experience of the former Travancore state administration in the use of Ascu-treated teak poles for telecommunication lines.

4626 Diggelen, C.H.P.C.van. 1922. **Mixture of the products of the Government teakwood etc. 1916 to 1922**. Tectona 15: 541-544.

4627 Dommergues, Y; Maheut, J. 1962. **Utilisation du teak. Pour la Mise en valeur des forests de basse et Moyenne Casamance**. Conference des Nations Unies sur, Applications de la Science et de la Technique E. Conf. 39/c/45: 4, FAO, Rome.

4628 Draaisma, C.L.M. 1917. **A rational exploitation of teakwood**. Tectona 14: 525-534.

4629 FAO. 1957. **Activities of the utilisation working party**. FAO Teak Sub-Commission, Bandung FAO/TSC-57/11: 5p.

4630 FAO. 1957. **Note on utilisation of teak: Indonesia-III. Conversion**. FAO Teak Sub-Commission, Bandung FAO/TSC-57/30: 2p.

Sawing, veneer cutting, storage, treatment, rotary and excentric cutting, glueing and pressing and prospects of a new market for teak veneers for profitable utilization are dealt with.

4631 Forest Products Research Board, London. 1952. **Flooring tests**. Report of Forest Products Research Board, London 1951: 12-13.

Results of the preliminary experiments on moisture content and dimensional changes in strip floor samples of species including teak are presented.

4632 Garay, J.D.A; Duran, P.J.A; Moreno, P.P.A. 2001. **Particleboards from *Melina* and teak species**. (Spanish). Revista Forestal Venezolana 45(2): 205-212.

Boards made from Melina and teak were tested for its mechanical and physical properties. Static bending and tension perpendicular to the board surface tests determined the mechanical properties. The physical properties were evaluated by the thickness, dimensional stability and the water adsorption by water soaking tests.

4633 Limaye, V.D. 1941. **Wooden poles for overhead electric transmission**. Indian Forest Leaflet 8 (Utilization series).

The standard dimensions of wooden poles of different species including teak for different heights by strength classes are tabulated.

4634 Maung, U.W. 1956. **Teak dome building of the engineering college of the university of Rangoon, Burma**. Burmese Forester 6(1): 80-83.

4635 Mishra, H.N. 1997. **A case study on teak structure**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 205-207. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

The paper discusses the possibilities of rehabilitation of partially worn out teak structures of a prestigious building constructed about 200 years back using quality teak in roofs and floors. How the decay and deterioration of the left-over wooden components can be arrested and structural members renovated by incorporating timber engineering techniques have also been elaborated.

4636 Mishra, H.N. 1997. **Teak - the standard timber for structural use**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 199-202. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

The paper discusses the correct use of the costly timber, teak even in smaller forms

for bigger structures by joining them with modern fastening devices.

4637 Moore, D. 1962. **The utilization of hardwood (teak-*Tectona grandis* Linn.f.) thinnings in Trinidad and Tobago**. Eighth British Commonwealth Forestry Conference, East Africa, 1962. Government Printing Office, Trinidad: 5p.

4638 Munz, W. 1960. **Working teak**. (German). Verlag und Holzfachbuchdienst Holz, Merling b. Augsburg: 74p.

A practical manual intended for furniture manufacturers using teak.

4639 Myint, U Thein; Kyi, U Win. 1988. **The utilisation potential of teak tops and lops**. Burma, Forest Research Institute: 26p.

The paper dealt with the determination of waste of teak tops and lops left in the forest after extraction. It shows that about 31.5 percent of the tree was left in the forest.

4640 Nair, V.R.K. 1997. **Utilization aspects of teak**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 179-184. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Being light, strong and durable, teak wood is superior to every other kind of wood. Once seasoned, teak will not split, crack, shrink or warp. Teak grown under different climatic conditions exhibits differing qualities. The management of teak is tailored to suit its utilization aspects. The logging methods now employed require further improvements to reduce wastage to the minimum so as to obtain maximum quantity of timber and thereby obtain maximum of revenue. Though Kerala is one of the largest producers of teak in the country, it is beyond the means of the common man in Kerala to go in for teak for his use on account of its high price in the market.

4641 Namasivayam, M. 1965. **Making use of our forest resources**. Ceylon Today 14(7): 25-27; 32.

A general article on forest area and composition, timber potential, reforestation with teak and other species, economics and prospects including forest industries.

4642 Nanda, J.R; Krishnaswamy, K.R. 1968. **Indigenous woods for power transformers**. Electricity India 8(2): 31-35. Forest Research Institute, Dehra Dun.

Beech wood popularly used for distribution transformers, can be replaced by teak and other species as per studies conducted.

4643 Narayanamurti, D. 1948. **Note on treated wooden transmission poles in India**. Indian Forest Bulletin 140.

The bulletin deals with the selection, treatment, care etc. of wooden transmission poles. Teak is one of the species dealt and its relevant properties for use as transmission poles are presented.

4644 Olorunisola, A.O. 2003. **Teak production, processing and utilization in Nigeria**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

Information on the current status of production, processing and utilization of teak in Nigeria is presented. Findings indicated that teak is plantation grown in the government owned forest reserves in Nigeria. About 70,000 ha. of teak plantation is now existing in Nigeria, which make the country the largest teak producing nation in Africa. Nigerian grown teak is moderately hard, strongly scented, dark golden yellow in colour when freshly cut and light brown when dry. It is commonly used in the country as furniture components, telegraphic poles, floor parquette production, fuelwood and charcoal making.

4645 Pruthi, K.S. 1997. **Prospects of conserving teak by using alternative species**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 191-198. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

There are many alternative species which are superior in strength and equivalent in durability with teak. Selection of correct species for structures would help to conserve teak for more important export-oriented purpose.

4646 Ross, P. 1958. **The utilisation of teak in Trinidad**. Caribbean Forester 19(3/4): 80-85.

Describes the Forest Department's intiations for utilizing thinnings from teak plantations, which include a fencing factory, sawmill and creosoting plant.

4647 Sangkul, S. 1995. **Processing and development technology and future: Trend for utilisation**. 2nd Regional Seminar on Teak, Yangon, Myanmar, FAO Document 9.

4648 Sangkul, S; Piam-a-roon, A; Laothai, P. 1992. **Lumber recovery of small size teak logs from thinning**. Proceedings of the Seminar on 50 Anniversary of Hyay-Tak Teak plantation, Bangkok, 5-8 August 1992.

Plantation grown teak logs of 2.50 m long with diameter ranging from 9-20.5cm harvested by selected crown-thinning practice from 20 year old trees of Maemai Plantation of Forest Industry Organization in Lampang province were cut by using through and through method. The average lumber recovery was 51.38 percent.

4649 Santhakumaran, L.N; Rao, K.S; Srinivasan, V.V. 1997. **Performance of teak in marine exposure trials in Indian waters and some aspects of its utilization**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 185-190. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Results of the performance of teak in marine exposure trials conducted at various localities along the Indian coast over the past few decades are examined with a view of providing suggestions for its proper utilization. Aspects covered include principal marine borers damaging teak, virulence of their attack and the resistance of teak to biodeterioration and the preservative treatment.

4650 Sekhar, A.C. 1960. **A note on some trends in teak utilisation in India**. FAO Sub-Commission, New Delhi FAO/TSC 60/4.12: 5p.

Some recent trends in utilisation, availability and indigenous production in India, together with market trends, uses and substitutes, grading and technological and research trends is discussed.

4651 Sekhar, A.C. 1962. **A note on some recent trends in teak utilization in India**. Journal Society of Indian Foresters 2(2): 29p.

Covers availability, market and trades trend, quality selection, seasoning, durability, strength, uses and substitutes in railway, structures, ship building and boat buildings, lorry body construction, agricultural implements, furniture, teak stock, grading, technological and research trends and physical and mechanical properties of teak in India.

4652 Soerjohadikoesoemo, D. 1970. **Influence of the methods of manufacturing sleepers for the Indonesian State Railways on prime costs and the prevention of waste**. Rimba Indonesia 15(3/4): 131-138.

A cost study showing economic savings in the production of teak sleepers by sawing as compared with the wasteful conventional method of manual hewing.

4653 Sutigno, P; Evans, P.D. 2002. **Effect of aqueous extraction of wood-wool on the properties of wood-wool cement board manufactured from teak (*Tectona grandis*)**. Wood Cement Composites in the Asia Pacific Region. Proceedings of a Workshop, Canberra, Australia, 10 December 2000: 24-28. Australian Centre for International Agricultural Research, Canberra, Australia.

Extractives in teak inhibit the setting of cement and reduce its suitability for the manufacture of wood cement composites. Aqueous extraction of wood wool is found a very effective method of increasing the suitability of teak for the manufacture of wood wool cement board.

4654 Trotter, H. 1940. **Manual of Indian forest utilization**. Oxford University Press, London: 360-363.

Along with descriptions of other Indian woods - their anatomical structure, properties and uses etc. of teak is dealt with on pages 360-363.

4655 Troup, R.S. 1909. **Indian woods and their uses**. Indian Forest memorandum 1(3). Forest Research Institute, Dehra Dun.

Gives notes on teak, its habitat, description, wood and principal uses.

4656 Troup, R.S. 1911. **Indian woods and their uses**. Government of India Press, Calcutta: p256.

4657 Vallil, G. 1997. **Utilization of teak**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 175-178. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

It is dealt with all aspects of utilisation of teak in India. To meet the increasing demand for teak wood and to bridge the gap between demand and supply, increased production and more efficient utilization are suggested.

4658 Vreeling, L. 1941. **Fences against wild animals in Ponorogo**. Tectona 34: 461-464.

Suitable fencing out of teak thinnings is made to protect agricultural crops from wild pigs.

4659 Woods, R.P. 1950. **Comparative decking experiments**. Review of Timber Development Association 2(10): 13-15.

Describes the experiments with ships decking laid on a New Zealand shipping company vessel, wherein teak and other timbers were used.

Go top

Wood Composites

4660 **Suitability of teak for veneers**. Indian Forester 54(1), 1928: 45-46.

Reports the use of teak for veneering and flooring planks and its use in USA for fancy cabins, pleasure boats and larger yachts, flooring and interior work of fine residences, club rooms and bank buildings.

4661 **Plywood and veneer in South Africa**. Industrial Reference Service of U.S, Department Communication 4 (Part 6, No.47), 1946: 3p.

Discusses imports for the period 1934-39 and impetus received to South African plywood industry and then decline observed since 1943. Species used include teak along with several other species.

4662 Badejo, S.O.O. 1989. **Influences of pre treatment temperature and additive concentration on the properties of cement bonded particleboard from plantation grown tropical hardwoods**. Tropical Science 29(4): 285-296.

Modulus of rupture and swelling properties of cement bonded particleboards, fabricated from three plantation grown tropical hardwoods including teak were evaluated using two pre treatment production variables of hot water temperature and additive concentration. Use of hot water at the higher temperature led to production of stronger, but less moisture resistant boards. Incorporation of aluminium sulfate into the panels resulted in stronger and more dimensionally stable boards.

4663 Beyse, R. 1991. **Production of teak wood is possible in Brazil too. A German veneer producer participates in a model forest enterprise in the tropical region**. Holz Zentralblatt 117(50): 785-786.

4664 Bhargava, P.N. 1955. **Examination of Indian cellulosic materials-woods, shrubs and herbs, (Central Province teak; Burma teak)**. Journal of Scientific Research, Banaras Hindu University 5(1): 149-154.

Forty different varieties of cellulosic materials commonly found growing fairly abundantly in trees, shrubs and herbs including teak have been examined from the physical, chemical and histological points of view.

4665 Chen, T.Y; Hwang, S.R. 1998. **Effect of wood species on the properties of cement-bonded wood particleboard**. Adhesive technology and bonded tropical wood products: 554-564. TFRI Extension Series 96. Taiwan Forestry Research Institute, Taipei, Taiwan.

Five native hardwood species of Taiwan were used in manufacturing cement-bonded wood particleboard. The compatibilities of hardwood species with portland cement were examined by measuring the setting time and compressive strength of wood particle portland cement mixtures. The mechanical properties of cement-bonded particleboard of *Tectona grandis* and *Albizia falcata* with three percent calcium chloride addition were found the best.

4666 Corne, M; Descos, J; Lucante, C; Roth Meyer, M. 1978. **The effect of veneers and finishings used in cabinet making on the flammability of fire-proofed panels**. (French). Courrier de l'Industriel du Bois et de l'Ameublement 2-78: 14p.

An investigation measuring the effect on the properties and fire classification of fire proofed particleboard of veneering with species including teak.

4667 Das, A; George, J. 1969. **Suitability of some Indian timbers for portland cement bonded woodwool boards**. Journal of Timber Development Association, India 15(2): 21-25.

Of fifty Indian wood examined for woodwool board manufacture teak was found to possess satisfactory strength properties absorption capacity of hydration heat of wood cement mixes.

4668 Dokania, L.N. 1973. **Export possibility of plywood from India**. IPIRI Journal 3(1): 3-6.

It is suggested that the plywood industry should be developed, with a view to exports, especially in the Andaman and Nicobar Islands and that the export of Rosewood and teak veneers should be undertaken.

4669 Elmendorf, A. 1967. **Some requirements of hardwood veneer flooring**. (German). Holz als Roh-und Werkstoff 25(1): 32-35.

Discusses the requirements, manufacture, installation, finishing and properties of hardwood veneer floor tiles.

4670 Forestry and Forest Products Research Institute, Japan. 1978. **Properties of some Papua New Guinea woods relating with manufacturing processes. IX. Plywood, particleboard, cementboard, pulp and charcoal from some West New Britain woods**. (Japanese). Forestry and Forest Products Research Institute, Japan, Bulletin 299: 151-187.

A description is given of the utilization of twenty three species including teak in several industrial processes, the problems associated with particular species and methods of reducing these problems.

4671 Fukuhara, Y; Komura, S; Suzuki, I. 1972. **On the penetration of light through wood veneer and the reflection on wood surface in hardwoods**. (Japanese). Bulletin of the Utsunomiya University Forests 9: 15-25.

The relative intensity of penetrating and reflected light was measured by two improved types of apparatus on hardwood veneers, mostly of *Zelkova serrata* and *Tectona grandis*.

4672 Gnanaharan, R; Dhamodaran, T.K. 1985. **Suitability of some tropical hardwoods for cement bonded wood wool board manufacture**. Holzforschung 39(6): 337-340.

Extracts of thirteen tropical hardwoods including teak in cold water, hot water and 0.5 NaOH solution were compared with those of *Pinus khasya* in relation to their inhibitory effect in cement setting. A knowledge of the pH of cold water, hot water and mild alkali extracts and the extent of acidity will help not only in screening suitable species for cement-bonded wood-wool board manufacture but also in choosing the suitable method of extraction.

4673 Gulati, A.S; Jain, J.D. 1980. **A note on the water absorption and swelling properties of commercial particle boards**. Indian Forester 106(6): 418-423.

Changes in length and width were all less than 0.5 percent of initial values after seven days. At least 50 percent of the changes in moisture content and thickness occurred in the first 24 h.

4674 Gupta, R.C; Jain, D.K. 1980. **Effect of resin treatment on the properties of veneers at various stages**. Indian Forester 106(10): 726-731.

Density, tensile strength, MOE and MOR were measured of 1.5-mm veneers of nine Indian species including teak at four stages of treatment with PF resin, viz. impregnated, impregnated and air dried, impregnated and cured and cured and water saturated.

4675 Hayashi, D; Tochigi, T; Inoue, H. 1970 . **Machinability of thin thickness veneers**. Wood Industry 25(12): 25-28.

A study illustrated with graphical data on the cutting of thin veneers from wood of species including *Tectona grandis*.

4676 Hwang, S.R; Chen, T.Y. 1992 . **Cement bonded wood particle boards - (I) Setting properties of the cement mixed with wood particles**. Forest Products Industries 11(4): 52-67. Harare, Zimbabwe.

Examined the compatibility of different wood species including teak particles with portland cement by setting time and compressive strength test.

4677 Indian Standards Institute, New Delhi. 1957. **Specifications for medium strength air craft plywood, IS: 809, 1957**. Indian Standards Institute, New Delhi .

Tectona grandis is a suitable species for manufacture of air craft plywood.

4678 Indian Standards Institute, New Delhi. 1957. **Specifications for marine-plywood IS: 710**. Indian Standards Institute, New Delhi .

Teak is a suitable species for manufacture of face veneers, core and cross-bands.

4679 Indian Standards Institute, New Delhi. 1958. **Timbers for decorative plywood IS: 1328**. Indian Standards Institute, New Delhi .

Tectona grandis is considered as a suitable species for manufacture of decorative plywood.

4680 Indian Standards Institute, New Delhi. 1960. **Specification for plywood for general pur-**

poses IS: 303. Indian Standards Institute, New Delhi .

Teak comes under class I list suitable for manufacture of plywood for general purpose.

4681 Indian Standards Institute, New Delhi. 1960. **Specification for block boards IS: 1959**. Indian Standards Institute, New Delhi .

Teak comes in class I list suitable for manufacture of block-boards.

4682 Indian Standards Institute, New Delhi. 1964. **Specifications for plywood tea-chests (Revised) IS: 10, 1964**. Indian Standards Institute, New Delhi .

Tectona grandis is found suitable for manufacture of plywood tea chests.

4683 Indian Standards Institution, New Delhi. 1988. **Specification for teak logs for production of sliced veneers**. Indian Standard 5248-1988. Indian Standards Institution, New Delhi.

4684 Jain, N.C. 1966. **Studies on peeling characteristics of Indian timbers-Part I**. Holzforschung und Holzverwertung 18(6): 108-109.

Preliminary tests were made at Dehra Dun with species including *Tectona grandis*. Veneer quality increased with decrease of cutting resistance.

4685 Jain, N.C. 1968. **Slicing characteristics of Indian timbers**. Holzforschung und Holzverwertung 20(3): 59-61.

Reports the effect of horizontal and vertical knife gap on veneer quality and uniformity of thickness in species including *Tectona grandis*.

4686 Jain, N.C (et al). 1968. **Peeling characteristics of Indian timbers. Part 4: *Tectona grandis* (teak)**. Holzforschung und Holzverwertung 20(4): 76-79.

Optimum conditions were found.

4687 Jain, N.C; Bist, B.S. 1971. **Comparison of strength properties of plywood from peeled and sliced veneers. Part I**. Indian Forester 97(8): p476.

Data are tabulated on glue adhesion, tensile strength, bending strength, panel shear strength and compressive strength for plywood made from peeled and sliced veneers of species which include *Tectona grandis*.

4688 Jain, N.C; Gupta, R.C. 1969. **A note on complete utilisation of trees**. Indian Forester 95(12): 841-848.

Gives results of work done at the Forest Research institute, Dehra Dun, on strength properties of *Tectona grandis*. Data are given for veneers, particle boards, fibreboards, plywood and boards obtained by thermal plasticization of leaves and of sawdust.

4689 Joesoef, M; Kasmudjo. 1979. **The manufacture of cement board from teak wood veneer waste**. (English; Indonesian). Duta Rimba 5(30): 14-23.

4690 Karnasudirdja, S. 1989. **Strength of glue laminated timber made from three wood species**. (Indonesian). Jurnal Penelitian Hasil Hutan 6(5): 281-287.

Data are presented on the bending strength, compressive strength and shear strength of solid and laminated samples of three species which include teak.

4691 Karnphanich, P. 1968. **Preliminary study on the particle board made from teak saw-dust with various quantity of lac**. (Thai). Student Thesis. Kasetsart University, Bangkok.

The particle board made with twenty percent lac and sawdust of teak is better than particle board with 10 and 15 percent lac, except for water absorption percent. The nail holding capacity and modulus of rupture is lower than standard level.

4692 Kliwon, S; Memed, R; Iskandar, M.I. 1997. **Properties and utilization of teak wood for wood composite products**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 203-204. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

The paper discusses the research results on utilization and the properties of teak wood as a raw material for wood composite products, such as decorative veneer, particle board, and wood wool cement board.

4693 Kristnabamrung, W; Takamura, N. 1972. **Suitabilities of some Thai hardwoods and coconut-husk fibre for manufacturing hardboards by wet and dry processes**. Thai Journal of Agricultural Science 5: 101-125.

The hardwoods tested include *Tectona grandis*. *T. grandis* was found suitable for dry but not wet processing.

4694 Kumar, C.P.S; Bhatnagar, M.S. 1960. **Study of various cellulosic materials used as filler in molding powder II. Effect of particle size on the bulk density**. Indian Pulp and Paper 15: 325-327; 330.

Cellulosic materials used include that of teak wood.

4695 Kumar, V.B; Kohli, R.C. 1967. **Studies on surface spread of flame in particle boards**. Holzforschung und Holzverwertung 19(6): 115-117.

Thirty two kinds of board of Indian manufacture showed roughly linear decrease in flame spread with increasing density. Teak chipboard had the lowest flame spread.

4696 Lii, W.J; Liu, C.T. 1992. **The effect of repetitive loading on the properties of laminated wood**. Forest Products Industries 11(3): 34-44.

A study was made of the properties of common teak laminated wood with different lamina thickness and adhesives and their properties under repetitive loading.

4697 Liu, C.T; Lii, W.J. 1990. **Effect of physicochemical properties and gluing methods on the qualities of laminated wood made from fast-growing species (11). Studies on the fabrication of laminated wood from Taiwan red pine, Honduras mahogany and common teak**. (Chinese). Forest Products Industries 9(3): 11-22.

Bending strength was determined for laminated wood made with resorcinol formaldehyde, urea formaldehyde or polyvinyl acetate glue and wood of Taiwan which include teak.

4698 Liu, C.T; Lii, W.J. 1994. **The creep behaviour of laminated woods from fast-growing tree species under long-term loading (II) - effect of various species on the creep behavior of laminated wood**. Quarterly Journal of Chinese Forestry 27(1): 67-82.

4699 Liu, C.T; Lii, W.J. 1995. **The creep behaviors of laminated woods from fast-growing tree species under long-term loading. (III). The bending properties and creep behavior of end-to-end grain jointed laminated wood**. Quarterly Journal of Chinese Forestry 28(3): 117-131.

4700 Merrick, M.J; Knapp, A.B. 1968. **The bowing of panels: An interim report**. FIRA Technical Report Furn. Industrial Research Association, Stevenage 31: 34p.

Discusses the basic causes of bowing in veneered and other composite panels and examines in detail four case histories illustrating the principles involved which include of teak veneered wardrobe door.

4701 Nagle, W. 1934. **Testing of Indian timbers for veneer and plywood**. Indian Forest Records 20(14): 56p.

4702 Nagle, W. 1937. **Testing of Indian timbers for veneer and plywood**. Indian Forest Records (n.s.) Utilization 1(5): 115-141.

4703 Narayanamurti, D; Aswathanarayana, B.S. 1970. **Creep behaviour of materials from teak wood**. (German). Holztechnologie 11(2): 116-119.

The creep under bending load of solid teak and of plywood and laminated wood made from teak veneers was measured under constant climatic conditions.

4704 Narayanamurti, D; Gupta, R.C; Singh, J. 1962. **Measurements of swelling pressure on wood-based plastic boards**. Holz als Roh-und Werkstoff 20(3): 89-90.

The results of measurements of swelling pressure made on plastic boards from species including *Tectona grandis*.

4705 Narayanamurti, D; Jain, N.C; Singh, K. 1962. **Utilization of Rajasthan teak**. Research and Industry, New Delhi 7(3): 88-90.

Reports on a preliminary survey of the suitability of billets often crooked for making veneer, fibreboard and chipboard.

4706 Pound, J. 1965. **Laminated window frames**. Wood 30(6): 69-71.

Describes the technique of using R.F. heating to glue teak facings to softwood in the manufacture of parts for window frames.

4707 Prasad, B.N. 1957. **Chipboards from Indian timbers**. Research and Industry, New Delhi 2(11): 293-297.

Presents tabulated results of preliminary tests on physical and mechanical properties of boards from materials including *Tectona grandis*.

4708 Raghavendra, B.G; Nagaraju, S. 1976. **Optimizing the trim allowance in plywood manufacture**. IPIRI Journal 6(1): 1-9.

Appropriate data and calculations are given for the optimum trim allowance in a plywood mill in India producing decorative teak veneers.

4709 Raknes, E. 1963. **The gluing of teak**. (Norwegian). FIRA Bulletin Transl. Furn. Industrial Research Association, Stevenage 12.

A study of the gluability of teak with various adhesives.

4710 Ramamritham, S; Narasimhan, R. 1954. **Use of indigenous timber for development of air-craft quality plywood (teak)**. Composite Wood 1(6): 138-144.

Teak though a good structural timber does not appear to be quite suitable for use in aircraft quality plywood as the samples tested lacked in proper bending qualities and also had knots in veneers resulting in a weakening in the tensile and shear strength values.

4711 Sekhar, A.C; Jain, J.D. 1976. **A note on the physical and mechanical properties of commercial particleboards**. Journal of the Indian Academy of Wood Science 7(1): 25-30.

The properties of 6-, 13-, 19-, and 35-mm thick three-layered boards made from mixed hardwoods and of 19-mm thick boards made from teak were determined by various tests.

4712 Seth, V.K. 1974. **Prospects of veneering and plywood industries in Madhya Pradesh**. Indian Forester 100(10): 601-605.

The costs of establishing the veneering and plywood units, the volume of teak and miscellaneous timber required and the plywood output of the units are discussed.

4713 Sivananda, V. 1992. **The problems and prospects in producing plywood from small diameter logs**. National Conference - Standardisation and Quality Upgradation of Lignocellulosic Panel Products, New Delhi.

4714 Suh, J.S; Doh, G.H; Kim, S.K. 1989. **A study on the wood adhesion techniques for furniture use. (I). Properties of fancy veneer-overlaid panel**. (Korean). Research Reports of the Forestry Research Institute Seoul 39: 24-31.

Adhesion quality was tested for veneers made out of the species including teak which were glued onto 3, 6 or 9 mm-thick plywood, particleboard or fibreboard. Veneer shrinkage and abrasion resistance were in the order oak, elm, teak and paulownia.

4715 Tan, Y.E; Mohd Shukari Midon; Mohd Zaini Ujang. 1992. **Bonding quality as a means for assessing Malaysian timbers for structural glue-lamination**. Journal of Tropical Forest Science 4(4): 331-339.

Seven local timbers including teak were glued with phenol resorcinol formaldehyde adhesive and evaluated for both interior and exterior structural glue lamination based on their bonding quality.

4716 Wang, S.Y; Kuo, P.W. 1996. **Studies on the static frictional behaviours of wood based flooring materials**. Forest Products Industries 15(3): 369-390.

The frictional properties are studied of the flooring materials made out of the species including teak.

4717 Wang, S.Y; Lay, K.J. 1979. **Studies on the control and prevention of the surface checking of fancy plywood (II) Black walnut and teak fancy plywood**. (Chinese). National Taiwan University, Experimental Forest, Technical Bulletin 124: 103-128.

Tests of the effects of moisture content, various types and amounts of adhesives and impregnation with PEG.

4718 Wong, W.C; Wong, C.N. 1982 . **Stains on furniture with teak overlay**. Malaysian Forester 45(1): 94-100.

Stains are found to develop gradually on components made from plywood groundwork surfaced with decorative teak veneers resulting in their later rejection and financial loss.

4719 Yagishita, M; Okanishi, T. 1964. **Studies on surface checking in plywood. Report I**. Bulletin Forest Experiment Station, Meguro, Tokyo 167: 29-42.

Face veneers of nine species were bounded to nine plybases with the fibres parallel or at right angles to those of the next sheet. All species showed in increased checking under treatment, the main sites of checks being the interior or the vicinity of the rays, and vessels appearing at the surface, particularly those cut obliquely.

Go top

Fodder, Medicinal, etc.

(See also 0598, 0612)

4720 Anbarasu, C; Dutta, N; Sharma, K. 2001. **Use of leaf meal mixture as a protein supplement in the rations of goats fed wheat straw**. Animal Nutrition and Feed Technology 1(2): 113-123.

Determined the replacement value of *Leucaena leucocephala-Morus alba-Tectona grandis* in the ratio 2:1:1 leaf meal mixture as a nitrogen source in conventional supplements for female goats. Leaf meal mixture could be used as a supplement like oil cakes when wheat straw is limiting the nutrient intake of goats and the leaf meal mixture could contribute up to 20 percent of the total DM intake.

4721 Anbarasu, C; Dutta, N; Sharma, K; Rawat, M. 2004. **Response of goats to partial replacement of dietary protein by a leaf meal mixture containing *Leucaena leucocephala*, *Morus alba* and *Tectona grandis***. Small Ruminant Research 51(1): 47-56.

It is reported that *Leucaena leucocephala-Morus alba-Tectona grandis* (2:1:1) based leaf meal mixture can be used inexpensively as a vegetable protein supplement to wheat straw based diets for goats without any adverse effect on voluntary intake, nutrient utilization, serum enzymes and immune status.

4722 Beri, R.M; Karnik, M.G. 1965. **Teak oil from *Tectona grandis* Linn.f.** Current Science 34(2): p48.

Data are presented on the properties of the oil obtained by steam distillation of the wood.

4723 Bhuyan, R; Saikia, C.N; Das, K.K. 2004. **Commercially adoptable process for manufacturing natural dyes for cotton**. Natural Product Radiance 3(1): 6-11.

Dyes are extracted from the leaves of *Tectona grandis* and the dyeing behaviors of the colour components on cotton are evaluated.

4724 Chakraborty, M.K; Bhattacharjee, A. 2003. **Plants used for thatching purpose by the tribals of Purulia District, West Bengal, India**. Journal of Economic and Taxonomic Botany 27(3): 571-572.

This paper deals with 16 species of plants which include teak, used by the tribals of Purulia district of West Bengal for thatching purposes. The leaves of teak are used for thatching roofs.

4725 Chopra, R.N; Nayar, S.L; Chopra, I.C. 1956. **Glossary of Indian medicinal plants**. Council of Scientific and Industrial Research, New Delhi: 240p.

Includes medicinal properties, local names and distribution of teak.

4726 Chow, P; Lucas, E.B. 1988. **Fuel characteristics of selected four year old trees in Nigeria**. Wood and Fiber Science 20(4): 431-437.

Stems of four year old trees including *Tectona grandis* were collected from a fuelwood plantation in Ibadan and the fuelwood characteristics of the species are studied.

4727 Dimmel, D.R; Sklar, P.I; Crews, K.E; Pullman, G.S. 2000. **Pulping catalysts in trees**. Journal of Wood Chemistry and Technology 20(3): 225-242.

Several hardwood and softwood trees were analysed for anthraquinone-type components. The anthraquinones were more concentrated in the heartwood of teak than in the sapwood.

4728 Ebdon, P. 2003. **Processing technology for value added products of teak from small and medium sized entrepreneurs of developing countries**. International Conference on Quality Timber Products of Teak from Sustainable Forest Management, Peechi, India, 2-5 December 2003. Kerala Forest Research Institute, Peechi; ITTO, Japan; Ministry of Environment and Forests, New Delhi; IUFRO.

One of the problems faced by wood entrepreneurs is drying the timber prior to the manufacture of various items. In order to get quality products from teak , it is suggested that the workforce should understand the different aspects of drying and methods to measure moisture content of wood, temperature, humidity, etc. either by providing simple to read printed materials or organizing small workshops. The initiative taken up by the Timber and Forestry Department of Enterprises in 1996 was found successful and conducted similar concerns in different countries. It is suggested that the woodworkers need to be educated on the importance of timber drying for the manufacture of wood products of superior quality.

4729 Guha, S.R.D; Pant, P.C. 1964. **Pulping of plywood veneer waste**. Indian Pulp and Paper 19(6): 393-395.

Plywood veneer waste of species including teak alone or in mixtures, after digestion in NaOH/Na_2S produces pulps for production of writing and printing papers.

4730 Guha, S.R.D; Singh, M.M; Saxena, V.B. 1961. **Chemical pulps for writing and printing papers from a mixture of broad leaved woods**. Indian Forester 87(7): 431-433.

Unbleached sulphate pulps in satisfactory yields and good strength properties useful for producing wrapping paper were produced from teak and other species.

4731 Guha, S.R.D; Singh, M.M; Saxena, V.B. 1961. **Chemical pulps from a mixture of broad-leaved woods**. Indian Forester 87(3): 194-197.

Unbleached sulphate pulps in satisfactory yields and good strength properties useful for producing wrapping paper were produced from teak and other species.

4732 Guha, S.R.D; Singh, M.M; Mathur, B.C. 1964. **Pilot plant production of wrapping and writing papers from a mixture of hardwoods**. Indian Forester 90(2): 755-757.

Experimental results on pilot plant scale indicated that mixtures containing species including *Tectona grandis* give pulps in satisfactory yields with good strength properties for production of wrapping and writing papers.

4733 Guha, S.R.D; Singh, M.M; Bhola, P.P. 1977. **Pulping of *Anogeissus* spp. and *Tectona grandis* (lops and tops) for newsprint**. Indian Forester 103(3): 196-202.

Optimum conditions of chemical concentration, sulphidity, temperature and time were found. Satisfactory newsprint was made by mixing *Anogeissus* or *Tectona* with 40 percent bamboo pulp.

4734 Gupta, R.S; Patle, B.R. 1993 . **Energy requirements of crossbred calves fed complete feeds based on poor quality roughages**. Indian Veterinary Journal 70(2): 148-151.

For crossbred cattle were given diets based on wheat straw or dry, fallen teak leaves as sole source of roughage for 28 days. The roughages were coarsely ground, treated with water and 4 percent urea and fed at 40 percent together with concentrate.

4735 Gupta, S; Uniyal, B.M. 2003. **Indian woods - their medicinal importance and identification**. Indian Forester 129(10): 1225-1239.

The article deals with the anatomy and medicinal value of the 25 Indian woods including teak that are well known for their medicinal properties and also useful timber. Images of transverse section have been added to show their gross structure.

4736 Gupta, V.C; Hussain, S.J; Imam, S. 1997. **Important folk-medicinal plants and traditional knowledge of tribals of Aurangabad and Nasik forest divisions of Maharashtra, India**. Hamdard Medicus 40(2): 59-61.

The forest types and products, geophysical characteristics and climate of Maharashtra are briefly described. The socio-economic status of the people and their herbal folk treatments for common ailments are briefly outlined. Fifteen plant species including teak used in such treatments are listed, in each case the scientific and common names, part of the plants used, mode of utilisation and name of the tribe who use the treatment is given.

4737 Haffner, L.C; Kobe, K.A. 1940. **Douglas Fir as a pulpwood**. Trade Journal 111(9): 93-98).

Young teak wood has little value as a raw material for paper-making owing to the short length of the fibres and to the difficulty in obtaining an easy-bleaching pulp.

4738 Hartoyo; Ando, Y; Roliadi, H. 1978. **Experiments on charcoal briquetting of five Indonesian wood species**. (Indonesian). Laporan, Lembaga Penelitian Hasil Hutan 103: 12p.

4739 Imperial Institute, London. 1940. **Young teak for paper making from Trinidad**. Bulletin Imperial Institute, London 38(3): 285-289.

4740 Jain, N.C; Singh, J. 1965. **Utilisation of tree leaves**. Paper Plastics 10(2): 18-19.

Suitability of the species including *Tectona grandis* leaves for use as filler extender in urea resins and for making plastic and particle boards was examined.

4741 Jain, S.K. 1969. **Medicinal plant lore of the tribals of Bastar**. Economic Botany 19(3): 236-250.

The oil is obtained by distillation of wood chips of *Tectona grandis* cure eczema and ringworm.

4742 Jauhari, M.B; Bhargava, R.L. 1976. **Mixed tropical hardwoods for pulping and papermaking**. IPPTA 13(4): 316-323.

Important variables that affect pulping quality in kraft semichemical pulping of mixed tropical hardwoods including teak are discussed. Chip size, cooking time, chemical consumption, pulp washing, pre-heating and disc refining are the variables noted.

4743 Kirtikar, K.R; Basu, B.D. 1933. **Indian medicinal plants Vol. III, 1924-26**.

Details of *Tectona grandis* - its habit of growth, botanical description, medical properties of various parts of the tree, distribution, local names etc.

4744 Komarayati, S; Ismanto, A; Angraeni, I. 1995. **Potential of forest plants producing traditional drugs**. Proceedings of the Second National Seminar and Workshop on Ethnobotany, Book 1 - Medicinal Plant, 1995.

Utilisation of traditional medicinal plants has been increasing recently. Some of these plants which grow well in teak forest of Java and used widely by Javanese.

4745 Krishna, S; Ramaswamy, S. 1930. **A note on the so-called teak oil**. Indian Forester 56(11): p483.

Products of destructive distillation of teak were given and crystalline compound quinone is isolated. The usual teak oil is identified as heavy tar product forming 10.6 percent of distillate.

4746 Kukde, R.J; Thakur, B.S; Mendhe, S.N. 1993. **Dried teak leaves as a source of fodder during scarcity**. Indian Veterinary Journal 70(11): 1069-1070.

Groups of bullocks were fed on diets containing conventional fodder (control), dried teak leaves and legume straw or teak leaves treated with urea. Bullocks did not maintain body weight when given teak leaves alone or with legume straw.

4747 Kukreti, D.P. 1930. **Timbers for bent wood furniture**. Journal of Timber Dryers' Preservation Association 4(3): 8-11.

Teak timber does not have good bending properties and it can be used for low curvature bends only.

4748 Kulkarni, L.B. 1909. **Drugs of Sirsi and Kappat hills**. Journal of the Bombay Natural History Society 19(3): p577.

Seeds of *Derris oblonga* well powdered and roasted with teak oil is a medicine for itching of skin.

4749 Masilungan, V.A, et al. 1959. **Screening of Philippine medicinal plants used in the treatment of tuberculosis for substance inhibitory to Mycobacterium tuberculosis-607**. Philippine Journal of Science 88(2): 245-251.

The species having marked antagonistic effect include *Tectona grandis*.

4750 Patle, B.R; Gupta, R.S; Teckchandani, C.K. 1990. **Development of a feed processing unit for preparing complete feed pellets based on dry fallen teak leaves for growing calves**. Indian Journal of Animal Nutrition 7(3): 185-190.

A complete processing unit consisting of leaf collector, grinder and a pellet mill was developed for the preparation of complete feed pellets based on dry fallen teak leaves. The nutritive value of these complete feed pellets is also reported.

4751 Puntambekar, S.V; Krishna, S. 1933. **Oil from the seeds of *Tectona grandis***. Journal of Indian Chemical Society 10: 401-403. Forest Research Institute, Dehra Dun.

Teak seeds - after crushing fruits and extraction with ether gave a bright red oil.

4752 Rai, P.A; Jaspal, N.S. 1976. **Mixed pulping of bamboo and hardwoods**. IPPTA 13(4): 328-339.

Kraft pulps were made from mixtures of bamboo and Indian hardwoods including teak.

4753 Reddy, G.V.N; Reddy, M.R. 1986. **Effect of ammoniation on the utilization of sawdust as sole source of roughage in complete pelleted diets for crossbred cattle**. Indian Journal of Animal Sciences 56(2): 248-253.

4754 Reddy, V.A; Reddy, M.R. 1984. **Utilization of fallen dry teak leaves (*Tectona grandis*) as roughage source in complete pelleted rations of sheep**. Indian Journal of Animal Sciences 54(9): 843-848.

Dry fallen teak leaves replaced 0, 25, 50 and 100 percent of dry mixed grass, mainly *Sehima nervosum* and *Heteropogon contortus*, in complete pelleted rations of sheep. It was suggested that dry teak leaves can be used to feed sheep.

4755 Sangat Roemantyo, H. 1990. **Ethnobotany of the Javanese incense**. Economic Botany 44(3): 413-416.

Notes are given on types of incense, plant and other materials used in incense, making of incense and ritual uses in Java. It is reported that sawdust of *Tectona grandis* can be used for making incense.

4756 Sharma, S.K. 1999. **Plants used as henna dye by Bhils of southern Rajasthan**. Journal of Economic and Taxonomic Botany 23(2): p257.

Plants used as a substitute for leaves of *Lawsonia inermis* by Bhils in Rajasthan include buds of *Tectona grandis*.

4757 Soni, P.L; Pal, R; Madan, R.N. 1980. **Utilisation of teak bark - Production of pulp for wrapping paper and cellulose derivatives**. Holzforschung und Holzverwertung 32(2): 46-48.

Analytical data are given for teak bark and for sulphate pulp made from it. The yield and strength properties of the pulp indicate that it could be used for low grade wrapping paper or for production of cellulose derivatives.

4758 Sood, V.K. 1974. **Indian essential oils: Review of work at Forest Research Institute**. Indian Forester 100(4): 259-264.

Essential oils from twenty two species including teak wood are reported.

4759 Spoon, W. 1944. **Barrels made of Indian wood**. Hout. 24(4): 17p.

Teak in Java makes good casks for shipping liquids.

4760 Tiwari, D.P; Baghel, R.P.S; Patle, B.R. 1987. **Use of dry fallen teak (*Tectona grandis*) leaves as roughage in complete feed for cross-bred calves**. Indian Journal of Animal Nutrition 4(3): 214-216.

Dry fallen teak leaves were included in complete diets for calves. Teak leaves intake, body weight gain and digestibility, crude protein, ether extract, crude fibre and nitrogen-free extract were lower in calves given DFTL. It was concluded that DFTL could not replace wheat straw without reducing its nutritive value.

4761 Triratana, S; Osathaphant, P. 1988. **The cultivation of shiitake (*Lentinus edodes*) in sawdust substrates from different trees and agricultural wastes**. Journal of Agricultural Research and Extension, Thailand 5(3): 122-133.

The growth and yield of shiitake cultivated in 16 combinations of different sawdust from tropical trees and some agricultural wastes were investigated. The substrates tested include teak sawdust.

4762 Watt, G. 1893. **A dictionary of economic products of India 1889-93 Vol. I-VI, Part IV**. Government of India Press.

Gives notes on teak and its resin, dye, oils, medicine, etc.

Go top

International Forest Policy

4763 Banerji, J. 1952. **International Teak Commission**. FAO/Asia Pacific Forest Commission, 2nd session of the Forestry and Forest Products Commission for the Asia and Pacific, Singapore FAO/APFC-52: 15p.

Teak is the most important timber and its continued and ever-increasing yield can be maintained when satisfactory artificial and natural regeneration methods are evolved. Proper logging, grading and marketing will redound to economy, usefulness and greater supply of timber. The author recommends constitution of an International Sub-commission with headquarters at Dehra Dun.

4764 Becking, W. 1930. **Water-transport: Official meeting of Teak Department with debate**. (Indonesian; English). Tectona 30: 1065-1074.

4765 Buchy, M. 1996. **Teak and arecanut: Colonial state, forest and people in the Western Ghats (South India) 1800-1947**. Publications du Departement de Sciences Sociales No 2: 255p. Indira Gandhi National Centre for the Arts, Institut Francais de Pondichery, Pondichery.

This book is an historical study of the destructive nature of colonial exploitation in North Canara in the Western Ghats of Karnataka.

4766 Duyfjes, J.J. 1915. **Some examples about the progress of Government teak wood policy in 1914**. (Dutch). Tectona 8: 123-124.

4767 FAO. 1952. **International teak commission: Comments by Indonesia**. FAO/Asia-Pacific Forestry Commission 72: 7p.

Notes on silviculture of teak plantations in Indonesia is given.

4768 FAO. 1955. **Forestry Agency Japan: Teak in Formosa, (Tropical silviculture)**. Proceedings of FAO/Asia-Pacific Forestry Commission FAO/APFC-55/53: 7p.

4769 FAO. 1955. **Japanese Government: Teak general situation in Japan**. Proceedings of Asia-Pacific Forestry Commission FAO/APEF-55/63.

4770 FAO. 1960. **Report of the third session of the teak sub-commission, New-Delhi, India, 8-10 February 1960**. FAO Teak Sub-Commission, New Delhi FAO/TSC-60/8/1 and FAO/APEC-60/10 a.1: 19p.

Reports on the 3rd session and recommendations are made mainly on teak bibliography, teak grown under exotic conditions, provenance trials, mensuration, increment and yield, girdling of teak, physical, chemical and mechanical properties of teak and country reports of progress in teak forestry are given. Details of silviculture, management, research, production, trade and prices, teak grading rules and other topics like multi-lingual terminology etc. are given.

4771 FAO. 1967. **History and achievements of the teak sub-commission**. FAO/Asia-Pacific and African Forestry Commission, Teak Sub-Commission, Fourth Session, Rome FO:T-67/2: 4p.

The history of establishment of Teak sub-commission and recommendations of its previous sessions are reviewed and achievements of TSC on bibliography, ecology and races, seed-races and silviculture and management inventories, trade, utilization, information and documentation etc. are reviewed and items are suggested for consideration for further work.

4772 Gartner, C. 1956. **National progress reports to the sub-commission on teak: Indonesia**. Teak Sub-Commission, Bangkok FAO/TSC-56/25: 59p.

Reports on ecology, seed problems, silviculture, management, utilisation and trade of teak are covered.

4773 Huguet, L. 1958. **Forest policy and its execution-report to the Government of Cuba**. FAO/EPTA-Report 876. FAO, Rome.

Report deals with introduction of teak in Cuba.

4774 Keogh, R.M. 2002. **Teak 21: A support mechanism for high-grade tropical hardwoods**. International Forestry Review 4(3): 239-243.

This paper outlines the extent of the crisis of the sustained supply of high grade tropical hardwoods and introduces a working solution to the problem.

4775 Kerala Forest Department. 1990. **Administration report of Kerala Forest Department 1988-89**. Kerala Forest Department, Trivandrum.

4776 Kunhi Krishnan, K.V. 1997. **Colonial state and the Malabar teak**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 222-225. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Studies on the historical roots of the problem of deforestation, to identify the interests behind the formulation and implementation of forestry policies, to trace the evolution of British colonial forest policy, and to analyse it as part of the socio-political system are covered.

4777 Nair, K.K. 1997. **A teak research institute in 1991 - the year of teak**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 212-215. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Teak plantations have been raised for 150 years and natural teak forests have been scientifically managed. Development of appropriate technique for natural regeneration in mature plantations, systematic collection and utilization of seeds from genetically improved seed stands, establishment and proper management of seed provenance, development of improved thinning methods in plantations and natural stands, genetic improvement of tree for desirable morphological traits, effective control measures against defoliators and stem borers, *Loranthus*, fire, animal injury, etc., proper soil conservation measures against deterioration of sites under teak monoculture, evolving suitable species of mixture and planting technique, etc. are required for proper management.

4778 Saleh, W; Nadiar, S. 1991. **The role of Perum Perhutani in increasing of the social welfare on surrounding forest area**. Forest Magazine of Perum Perhutani, Jakarta (133/134).

4779 Shanmuganathan, K. 1997. **Nilambur teak - the history and a resume of early planting activities**. Teak: Proceedings of the International Teak Symposium, Thiruvananthapuram, Kerala, 2-4 December 1991: 226-231. S. Chand Basha; C. Mohanan; S. Sankar, Eds. Kerala Forest Department, Thiruvananthapuram and Kerala Forest Research Institute, Peechi.

Nilambur forests is world famous for its plantation teak - Malabar teak. The efforts of the pioneers in teak planting are dealt with in this paper.

4780 TEAKNET. 1995. **TEAKNET: Asia-Pacific Region**. 16p. TEAKNET, Forest Department, Ministry of Forestry, Yangon, Myanmar.

The booklet describes the background, objectives, proposed activities, structure and resources for TEAKNET, a network to strengthen interaction among all those concerned with the conservation and sustainable management of teak bearing forests and plantations. Aims to facilitate exchange of technology and information on tree improvement, silviculture, management, harvesting, processing and trade of teak; assist in the exchange of genetic material, plants and wood samples, and standardize trials and methods which will enable international comparison; and promote collaborative studies on critical areas that are of common interest to member countries or institutes.

4781 Wirjodarmodjo, H; Soeroso, R. 1978. **History of Perum Perhutani**. (English; Indonesian). Proceedings of the 8th World Forestry Congress, Jakarta, October 1978. Duta-Rimba 4(26): 3-9.

This public enterprise was established in 1972 as a reorganization of existing state forest enterprises in Central and E. Java. Its history is traced back to the commercial enterprise Djatibedrijf set up by the Dutch administration in 1929 for the efficient production of teak in state forests. Its operations include processing and marketing of forest products.

Author Index

Ab Ghani, A.R 1520
Ab Rasip, A.G 1964
Abayomi, J.O 2000
Abbate, M.L.E 4077
Abd Kadir, J 380
Abdullah, R 983
Abdurachim, M.R.A 4453, 4454
Abegbeihn, J.O 2001
Abeysinghe, W.A.M.W.K.S.B 638
Abolarin, D.A.O 4078
Aborisade, K.D 166
Abraham, C.T 2630
Abraham, K.J 2688
Acharya, C.L 496
Achaya, T 3279
Ackhurst, P.W 3280
Adamson, A.M 4465
Adarsh Bala 1761
Adarsh Kumar 668, 1459
Addae Mensah, A 4393
Adegbehin, J.O 3281
Adejuwon, J.O 167
Adekunle, A.O 2002
Adeoye, K.B 502
Adetchessi, L 3752
Adeyeye, A 566
Adiody, P.N 2003
Adu Anning, C 2487
Adukkham, S 2267
Adyalkar, P.G 168
Adzmi, Y 571
Agarwal, D.C 4038
Agarwal, G.P 3040, 3041, 3129, 3184
Agarwal, S.C 567
Agarwala, V.P 1269
Agbavwe, C 3253
Agboola, D.A 1395, 1396, 1397, 1398, 1399, 2281, 2795
Agni, T 052
Agoramoorthy, G 154
Aguilar Molina, C.A 521
Aguinaldo, A.M 568
Aguirre, A 2335
Ahluwalia, V.K 569
Ahmad, I 506
Ahmad, I.U 2412
Ahmad, M 2796, 2797, 2798, 2862, 4455
Ahmad, W 506
Ahmad, Y.S 1244, 2004
Ahmed, G.U 3282
Ahmed, S.I 3130
Aighewi, I.T 310, 311
Aihara, H 2735
Aimufia, D.I 1811
Ainslie, J.R 3597
Aisagbonhi, C.I 2799
Aitchson, P.E 3598
Aiyar, M.R.S 1245
Ajmal, M 570
Ajoung, E.M.A 4183
Akachuka, A.E 4078
Akhtar, M.S 2862
Akindele, S.O 084, 169, 3283
Akinsanmi, F.A 053, 169, 739
Aksornroae, S 289
Alam, M.K 2626
Alam, T 2800, 2801
Albertin, W 080
Aleem, S.A 2005
Alexander, T.G 170, 171, 172, 187, 188, 189, 197, 2336
Alfaro Murillo M de los, A 3599
Alfonso, M 3424
Ali, A.R.M 3395
Ali, M.I.M 570, 2627, 2632, 2633, 2645, 2646, 2647, 2648, 2689, 3092, 3093, 3131, 3132, 3163, 3169, 3172, 3181, 3182, 3185
Ali, M.O 4261, 4300, 4565
Ali, M.S 472, 2800, 2801, 2802
Ali, S 1175
Alikunhi, K.H 4519
Allan, C.W 2337
Alliot, H 4537
Alloysius, D 892, 3290
Allsop, F 1246, 2006
Alphen de Veer, E.J van 1812, 2338, 2803
Alrasjid, H 766, 2339
Altona, T 1056, 1057, 1058, 1247, 1813, 2007, 2008, 2593, 2628, 2690, 2691, 2804, 3883
Alvarado, A 092, 2313
Alvarez, L 2384
Alvarez, R.S 2743
Amakiri, M.A 471, 2629
Amaral R do 1454
Amatya, S.M 020
Ambasht, R.S 460, 3284
Amin, P.W 2805, 2877
Amir Husni, M.S 173, 174, 302, 571
Amir Saaiffudin Kassim 1520
Amir, M 2806, 3207
Amos, G.L 674, 4304
Amoyaw, M.A 1814
Ampong, F.F.K 4539
Amponsah, G.I 175, 176
Anand, K 083
Anandalakshmi, R 1566
Ananthapadmanabha, H.S 2268
Anaz, M.A 3401
Anbarasu, C 4720, 4721
Anbazhagi, G 4143
Ancy Mathew 3983
Andersen, K.P 3285
Anderson, C 3962
Anderson, E.A 4301
Ando, K 177
Ando, Y 4738
Andrade Countinho, Sylvio de 021
Andre, A.M 4058, 4371, 4521
Andres, P.P 2769
Andrews, E.A 2807, 2808
Anekkana, S 2478
Ang, L.H 646
Angadi, V.G 285, 572
Angeles Martinez, M de los 2809
Angelo, H 3353
Angraeni, I 4744
Ani, J.R 1609, 1658
Anitha, V 2661
Aniwat Thunyathorn 1815
Anjana Rajput 846
Annadurai, K 609, 1507, 1514, 2298
Annamalai, R 1649
Anoop, E.V 014, 2630
Ansari, A.A 846
Ansari, M.Y 3756
Ansari, S.A 518, 1675, 1676, 1769, 1783
Ansep, T.T 2594
Anstruther, K 3600
Anuwatanawanaraksa, P 3884
Anuwongse, B 2810, 4460
Anvery, S.A.A 112
Anwar, M.N 488, 489, 500
Anwar, S 570
Apavatjrut, P 1677, 1679
Apetorgbar, M 4048
Aphawatcharut, P 1732
Apichart Kaosa ard 022, 097, 740, 741, 742, 743, 847, 848, 849, 850, 851, 852, 853, 863, 913, 946, 1042, 1059, 1610, 1611, 1612, 1677, 1678, 1679, 1816
Appelman, F.J 2009, 3286
Aranyaputi, S 4305
Arata, A.A 057
Arce, V.H 4079, 4223
Arce-Brenes, H 1817
Argal, A 366, 3885
Arief, S.M 4617
Arifin, M 2340

Arifin, Z 2488
Ariyadasa, K.P 023
Arkwright, P 3978
Armitage, H.P 1400
Armstrong, F.H 4546
Arnason, A 1048
Arndt, U 2811, 4456
Arockiasamy, D.I 1068
Arora, K.L 4201
Arora, R.K 178
Arpornratana, P 3287
Arreola Vazquez, M.C 2812
Arroyo-Castillo, E 1817
Arshad, M 2862, 4466
Arthur, M.B 2269
Arumugasamy, K 446
Arun Kumar, A.N 3288, 3438
Asa Prombubpa 2010
Asha Sinha 405
Ashiabor, W.K 4154
Ashutosh, S 3601
Asiddao, F 1818, 3289
Asikainen, A 4407
Askary, T.H 472
Asokan, A.M 1424
Asokan, P.K 1658
Aswathanarayana, B.S 4155, 4703
Atipanumpai, L 810
Atkar, R.B 3499
Atkinson, D.J 2813, 2814, 2815, 2816, 2817, 2818, 2819, 3133, 3134, 3602
Atuahene, S.K.N 2820
Augustin, H 4357
Aung Thant Zin, U 2341
Aung, D.U 1060, 1248, 1249
Aung, H 1176
Aung, K.M 3603
Aung, M.M 854
Aung, N.N 3604
Aung, T 1176
Aung, U.M 1250
Avella, T 4097
Aweto, A.O 166, 179, 406, 2011
Ayarkwa, J 4393
Ayyar, K.S 4306
Aziz, M.A 4556
Azizah, H 484
Azmy Hj Mohamed 3390
Babjan, B 3169
Babu, L.C 917, 918, 1479
Bachpai, V.K.W 1013
Bacilieri, R 3290
Bacon, P.R 3644
Baconguis, S.R 522
Badanur, V.P 227
Badejo, M.A 473
Badejo, S.O.O 4662
Baden-Powell, B.H 669
Badoni, S.P 4422
Badran, O.A 4183
Bagchee, K.D 2692, 2693, 2694
Bagchi, S 1401, 1621
Bagchi, S.K 670, 744, 855, 856, 857
Baghel, L.M.S 3886
Baghel, R.P.S 4760
Bagyaraj, D.J 508
Bahoenta, L 1680
Bahuguna, V.K 3442
Bai, S.J 3157
Bailey, R.L 3371
Bailleres, H 4080, 4120
Bajdalina, N.A 1819
Bake, H.W.A van den Wall 2489
Baker, R.E.D 4465
Baksha, M.W 2665, 2821, 2822, 2823, 2824, 2825, 2826
Bakshi, B.K 2575, 2695, 2696, 2699, 2777, 3074, 4457, 4458
Balagopalan, M 170, 171, 172, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 2270, 2274, 2336, 2595, 3487, 3605
Balaji, B 3434
Balaji, S 3434, 3435
Balakrishnan Nair, N 2827
Balamurugan, J 2199
Balasubramanian, A 573, 1885
Balasubramanian, R 858
Balasubramanian, V 1885
Balasundaran, M 2631, 2632, 2633, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2697, 2698, 4190, 4577
Bale, A 2271, 2342, 2343
Bali, B.I 4156, 4157, 4158, 4159, 4257
Bali, H.K 064
Ball, J.B 3606
Ballantyne, J 1820
Balooni, K 3607
Balu, A 2828, 2928
Bambang, A.S 2012
Baminiwatte, A.N.S 2344
Bamrungrars, P 1402
Bandara, G.D 3198
Bandara, T.M.J 523
Bandyopadhyay, A.K 296, 297, 298
Banerjee, A.K 198
Banerjee, K.L.B 054
Banerjee, M 303
Banerjee, S 2829
Banerjee, S.K 138, 199, 241, 248, 249, 250, 251, 303, 364, 365, 369, 436, 481, 4485, 4507
Banerjee, S.P 199, 200, 237, 238, 327, 353, 363, 368, 370, 371
Banerji, J 4763
Banerji, S.N 2699
Bang, Y.H 057
Banijbhatana, D 2490, 3608, 3609
Banik, R.L 024, 1403, 1404, 1646
Banjibhatana, D 2013, 3610
Bannerjee, K.K 1405
Banoewidjojo, M 1251
Bapat, A.R 1406
Barber, H 4538
Barbour, R 3611
Barcenas, A 671
Barizi 3512
Barnacle, J.E 4539
Barnard, R.C 2014
Barnes, A.H 4459
Barrance, A.J 1821
Barrantes, G 1407
Barrett, H.B 1252, 1253
Barrett, R.L 2272
Barrington, A.H.M 201, 202
Barrott, H.N 2015
Baruah, C.K 3326
Basak, A.C 2700
Basak, B 605
Basalingappa, S 2830
Basari, Z 2491, 2515
Basden, S.C 1613
Basu, A.C 2831
Basu, B.D 4743
Basu, P.K 1075
Basu, S 474
Basuki, T.M 203
Batey, T.E 4160
Batista, M.P 3291
Batra, L.R 2701
Bavendamm, W 4460
Baw, Shwe 3897
Bawa, K.S 1086, 2450
Bayoumi, A.A.M.S 4345
Beard, J.S 859
Beck, H.J.L 3612
Becker, G 4461
Becking, J.H 1177, 1254, 1255, 1822, 1823, 2016, 2017, 2492
Becking, W 2492, 4764
Beddome, R.H 3613
Bedell, P.E 1408, 1409
Bedi, S.J 1061
Bedwal, H.S 272, 273
Beekman, H 204, 672, 1256, 2018, 2019, 2020, 2021, 2832, 3292, 3293, 3294, 3614, 3615, 3616, 3617, 3618

Beekman, H.A.J.M 1824, 2022
Beer, J 1946, 2388
Beeson, C.F.C 2634, 2833, 2834, 2835, 2836, 2837, 2838, 2839, 2840, 2841, 2842, 3135, 3136, 3137
Begue, L 3619
Behaghel, I 025
Behari, B 3886
Behera, N 474, 1369
Bekker, C 3620
Bell, H.L 150
Bell, T.I.W 524
Bellers, H 2493
Bello, A 3623
Bellouard, P 2023, 3621
Benedikz, T 1048
Beniwal, B.S 1019
Bennet, S.S.R 980, 4143
Berdug, A 3979
Berger, L.G den 113, 4161
Beri, R.M 4722
Berkhout, A.H 3622
Berlage, H.P.(Jr) 717
Bermejo, I 3295
Bernasco, W 2702
Berninger, F 3431
Berquist, G 574
Berry, N 3885
Bertha, R.A 3623
Berti Filho, E 3035
Best, J.W 1178, 2673, 3624, 3625
Betancur Salgado, C.A 4162
Betts, T.F 2024
Beumee, J.G.B 114, 115, 2025, 2026, 2832, 3296
Beumee-Nieuwland, N 205, 206, 207, 208
Beversluis, J.R 3626
Beyse, R 1825, 4663
Bhadoria, H.B.S 407, 408, 409, 410, 575
Bhadraiah, B 475
Bhadran, C.A.R 2273, 3279, 3801
Bhalla, H.K.L 064
Bhamornsut, C 4188
Bhandari, A.S 2312
Bhandari, P.S 1660
Bhandari, R.S 2953, 3216, 3224
Bhargava, A 4483, 4484
Bhargava, K.S 494
Bhargava, P.N 4664
Bhargava, R.L 4742
Bhargava, S 4384
Bhargavarama, K.L 4231
Bhaskar, B 3113
Bhat, D.M 2260, 3297
Bhat, K.M 673, 727, 728, 745, 860, 2274, 3298, 3627, 3980, 3981, 3982, 3983, 4047, 4081, 4082, 4083, 4084, 4085, 4086, 4087, 4088, 4089, 4090, 4091, 4092, 4093, 4094, 4129, 4163, 4164, 4165, 4166, 4197, 4198, 4394, 4462, 4578
Bhat, K.V 2579, 2580, 3984, 4089, 4090, 4091, 4092, 4164, 4165, 4166
Bhatacharya, A 737
Bhatia, B.M 3138
Bhatia, D.N 4234, 4265, 4266
Bhatia, K 4306, 4327
Bhatia, K.K 055, 056, 116, 209, 210, 2345, 3232
Bhatnagar, H.P 634, 1614, 1681, 1682, 2275
Bhatnagar, M.S 4694
Bhatnagar, N.S 4167
Bhatnagar, V.S 3032, 3033
Bhatri, R.K 4267
Bhatt, R.G 1162
Bhatt, R.P 1061
Bhattacharjee, A 4724
Bhattacharjee, A.K 576
Bhattacharjee, D.K 4300
Bhattacharya, A 718, 808, 809, 1683
Bhattacharya, J 4095
Bhattacharya, P.K 4226
Bheemaiah, G 2276, 2378
Bhola, M.P 635, 1826
Bhola, P.P 4733
Bhople, R.S 2346
Bhowmik, A.K 147, 211, 320, 387, 388, 389, 1670, 2843, 2844, 3112, 4507
Bhudimitra, M 3299
Bhuijan, A.A 1827
Bhumibhamon, S 810, 1410, 1411, 3300
Bhuyan, R 4723
Bhyndum, K 1775
Bi, H.Y 470
Bianchi, A.T.J 3985, 4168
Biblis, E.J 4169
Bigger, M 2845
Bila, A.D 636
Billah, A.H.M.M 2027
Bingchao, K 861, 1412, 1684
Bingham, C.T 2846
Bisaria, A.K 3165
Bisht, A.P.S 1156, 1346
Bisset, I.J.W 674
Bist, B.S 4687
Biswas, S 2635
Black, S.J 3887
Blanco, E 2809
Blanford, H.R 1257, 1258, 1259, 1413, 1414, 2028, 2029, 2030, 2031, 3301, 3302,3986
Blay, D Jr 2487
Bloch, P 212, 2596
Block, F 3628
Blokhuis, G 3987
Boer R.C de 3629
Bohidar, N 2032
Boisson, C 1401
Bon, M.C 1685, 1752, 1753
Bonal, D 1686
Bonde 3988
Boomgaard, P 3814
Boonchai, K 213
Boone, R.S 2152
Boonkird, S 085, 637, 862, 930, 939, 1260, 1415, 1416, 1729, 2347
Boonmuang, B 1417
Boonplian, S 4127
Boonsomboon, P 2033
Boontawee, B 074, 863
Boonthavikoon, T 2559
Boonyasirkul, C 1418
Boonyawat, S 495, 525
Boonyoparch, C 3303, 3304
Booth, T.H 076, 3446, 3535
Boquel, G 411, 412
Bor, N.L 549, 864
Borgaonkar, H.P 722
Borse, S.S 3199, 3200, 3205
Bos, J.H 1828
Bose, R.K 2034
Bothmer K.H von 3630
Bouda, V 4307
Bouman, B.A.M 3843
Bourdillon, H 550
Bourdillon, T.F 551, 2847, 2848, 3989
Bourke, D.R.S 1419, 3949
Bourne, R 3305
Bowden, B.F 568
Bown, D.N 057
Box, J.E 3531
Boyce, J.S 2575
Boye, C 4170, 4333
Braat, C.G.S 2348
Bracamp, E.H.B 3888
Brahmachary, R.L 607
Braithwaite, J.D 3139
Branca, A 1062
Brandis, D 552, 1063, 1829, 3306, 3631, 3632, 3633, 4463
Branthwaite, F.J 2597
Brascamp, E.H.B 675, 1064, 1065, 1066, 1067, 1179, 1830, 1831, 1832, 1833, 2035, 2036, 2037, 2038, 2039, 2494, 3634, 3635,

3636, 3637, 3889, 3890, 3891, 3892, 3893, 3990, 3991, 3992, 3993, 4464, 4618, 4619, 4620
Brasnett, N.V 1267, 3307
Braun, D 4357
Brennan, G.K 4096
Brennan, P 3638
Briggs, J.L 3950
Briscoe, C.B 139, 1863, 2040, 2041
Britto, S.J 1068
Britton, R.A.J 4019
Britwum, S.P.K 865, 1687
Broeker, F.W 2703
Bromley, R.F 4308
Brooks, R.L 1261, 2042, 4465
Brown, A.G 746, 747
Brown, C 011
Brown, H.P 4240
Brown, S 3415
Browne, F.G 2558
Browne, R.S 3639, 3815
Bruce, C 1262
Bruin, J.H.S 214
Bruinsma, A.E.J 1069, 1263, 3640
Brunck, F 2043
Brush, W.D 3994, 3995
Bryant, C.L 2044
Bryant, R.L 2349, 2350, 2351
Bryce, J.M 4171
Bryndum, K 748, 811, 930, 1420, 1615, 1616, 1688
Buchy, M 4765
Budholiya, S.S 1160
Budiantho, D 2045, 3308, 3309
Budowski, G 1834
Buffe, J 3641
Buit, S.S 1264
Bultman, J.D 4526
Bunpromma, K 1854
Burger 2598
Burley, J 866
Burman, W 1835, 1836
Burmester, A 4172, 4173, 4174, 4309, 4310, 4311
Busbu, R.L 3829
Butranar, M 1421
Butt, R.A 1837
Butterwick, A.J 2046, 2495, 3894, 4395
Buvaneswaran, C 058, 456, 2352, 2447
Cadampog, Z 2379
Cai-Zemo 3996
Caldeira, S.F 1422
Calvo, G 1946
Camacho, M. P 059
Cameron, A.L 812, 867, 1386
Campbell, W.G 2849
Canadian Forestry Service, Ontario 2850
Canellas, I 3295
Cann, F.R 2851
Canning, F 1070
Cao, Y.H 1689, 1796
Capote, I 1695, 1696, 1697
Carapiett, J.B 4621
Cardoso, J.G Alfaro 026
Cardoso, N.da S 676, 736
Carle, J.B 3805
Carlisle 3895
Carpenter, P.H 2353
Carrapiett, J.B 1265
Carreras, R 4097
Carter, H 2599
Carthaus, E 1071
Caslam 3951
Castens, H.E 215, 216
Castillo, A 4332
Castro, F 4175
Cater, J.C 1266
Catinot, R 719, 2576
Caumartin, L 4058
Caveye 3997
Centeno, J.C 3642, 3816
Cermac, F 2496, 3643
Chable, A.C 1838
Chacko, K.C 190, 217, 218, 677, 915, 1038, 1423, 1424, 1473, 1474, 1589, 1639, 2047, 2274, 2674, 3015, 3018, 3372, 3526
Chacko, V.J 3491, 4119
Chadhar, S.K 868, 1690, 3140
Chaicharus, S 382
Chairuangsirikul, T 2559
Chaisurisri, K 1411
Chakrabarti, C 2277
Chakrabarti, S.K 3310
Chakraborty, M.K 4724
Chakravarthy, A.K 2852
Chakravarty, K.N 4095
Chalermpongse, A 2559, 2704, 3311
Chalmers, W.S 749, 3644
Chamnankit, S 1691
Champahaka, U 2705, 2706
Champion, H.G 117, 720, 750, 751, 1072, 1073, 1425, 1470, 1617, 2048, 2853, 2854, 3312, 3313, 3314, 3645, 3817
Champion, S.H 1267
Chamshama, S.A.O 219, 967, 2224
Chan, H.H 892
Chanchai Yarwudhi 3539
Chand Basha, S 001, 086, 196, 1472, 1473, 1474, 1589, 3601
Chand, G 401
Chandhrapanukorn, B 3315
Chandnani, K.N 3778
Chandola, L.P 4474
Chandra, A 2654
Chandra, K.K 476, 477, 490, 504, 1660
Chandra, S 2635
Chandrapala, A.G 638
Chandrasekar, P 118
Chandrasekharan, C 1074, 1180, 2102, 3998
Chandrasekharan, S 118, 3530
Chandrashekara, U.M 2354, 2355, 2356, 2357
Chang, L 2855
Changtragoon, S 869
Channal, H.T 577, 578, 579
Chanpaisaeng, S 743, 3316
Chantrakaew, K 1426
Chantraprapa, S 2358
Chaplin, G.E 1181, 1427, 1428, 1839
Chapman, J 3415
Chapuis, P 027
Chardin, A 2578
Charoenphaibool, W 1429
Chatopadhyay, S 2856
Chatruvedi, O.P 2800
Chatterjee, N 3646
Chatterjee, P.N 2634, 2857, 2858, 3137, 3141, 3142, 3154, 4524
Chatterjee, S.N 2859, 2860
Chatterji, A.L 2707, 3647
Chattoraj, G 303
Chaturvedi, A.N 3317, 3648
Chaturvedi, J.K 2049
Chaturvedi, M.D 1430
Chaturvedi, O.P 2802
Chaubey, A.K 220, 368
Chaubey, O.P 119, 120, 413, 1268
Chaudhari, N.R 870, 1618
Chaudhry, G.U 2861
Chaudhry, M.I 2862, 4466
Chaudhuri, A.B 1269
Chauhan, P.S 581
Chauhan, S.S 3398
Chauhan, V.S 087, 927
Chauviere, M 1755
Chava, S.R.K 314, 538
Chavan, A.S 221, 425, 600
Chavan, K.N 221, 425, 600
Chavan, M.R 2863
Chavan, P.D 2734, 2784
Chavan, R.R 4125
Chavan, S 4412
Chavan, S.A 2292
Chaves Salas, E 060
Chaves, E 4622
Chawdhry, P.K 3885

Chawhaan, P.H 789, 871, 872
Chelvarajan, B.K 4396, 4502
Chembukulam, S.K 4431
Chen, C.C 3122
Chen, C.T 1431
Chen, H.Y 398, 470
Chen, L.C 3914
Chen, S.S 4469
Chen, T.Y 4665, 4676
Chen, Y 485
Chen, Z.Q 2864
Chepsithar, S 3896
Cheriyan, C.J 4467, 4468
Cheriyan, P.V 2865, 4467, 4468
Cherrett, J.M 2866
Chetty, C.K.R 925
Chew L.T 4579
Chey, V.K 2867, 2868
Chhabra, N.N 776
Chhetri, H.B 1075
Chia, F.R 1692
Chiao, K.M 3318
Chibber, R.K 340
Chiew, A 2463
Chin, T 580
Chinchilla Mora, O 060
Chinnamani, S 3399
Chinniah, C 2869, 3221
Chinnusamy, C 2298
Chittranshi, V.N 3319, 3841
Chitwadgi, S.S 1270, 1271, 3319
Chobkai, S 1432
Choldumrongkul, A 1433
Choldumrongkul, S 222, 2870, 2871, 2872
Chollet, A 1076, 1182, 1272, 1840
Chong, L 478
Chongsuksantikun, P 223
Chonhan, J.S 1670
Choob Khemnark 452, 1000
Choosapya, Ch 3320
Chopra, I.C 4725
Chopra, R.N 4725
Chotimongkol, L 4188
Chotipatana, P 3649
Chotiyabutta, S 3321
Choubey, O.P 224
Choudhury, J 3128
Choudhury, J.C.B 2798, 3143, 3201
Choudhury, J.H 1643
Chow, P 4726
Chowdhury, A.M 3650
Chowdhury, K 2708
Chowdhury, K.A 678, 3322, 3999, 4000, 4098, 4099, 4100, 4101
Christoph, N 4207, 4436
Chuasawan, W 2050
Chugg, W.A 4397
Chung, D.H 4469
Chunkao, K 061, 525
Chuntanaparb, L 752, 1000, 1273, 1434
Chunwarin, W 4001
Clarke, S.H 4002
Clarke, W 4102
Clarson, D 225, 2636
Classen, J.C van R 062, 226, 679, 1841, 2051, 2497, 4623
Clifford, J.D 2052, 2359
Clubbe, C.P 2360
Cobbina, J 1629
Cobbinah, J.R 2873
Cole, I.S 4188
Commonwealth Forestry Institute, Oxford 873, 874
Connelly, S 875
Conolly, J.D 1274
Contractor, R.M 227
Contreras Miranda, W 4624
Contreras, G 3651
Contreras, M.O de 4624
Contreras, W 4540
Cooling, E.N.C 1842
Copleston, W.E 228, 1843
Corbett, D.C.M 2718
Cordero, L.D.P 3323, 3324, 3325, 4003, 4103, 4223
Cordes, J.W.H 553
Cores, E.C 2874
Corne, M 4666
Corner, E.J.H 1844
Corryanti 4142
Corryanti, T.W.N 1438
Corti, G 2679
Corti, G.R 153, 2678
Corvanich, A 4004
Costa, E.W.B da 4356, 4470, 4471, 4472, 4514, 4515
Costa, W.A.J.M de 638
Coster, C 063, 121, 122, 479, 554, 639, 640, 641, 680, 753, 754, 1183, 2053, 2278, 2279, 2361, 2362, 2498, 2499, 2500, 2637, 2709, 4104, 4176, 4177, 4312
Councler 4313
Crawley, M.J 2823, 2824, 2825
Creffield, J.W 2875
Crews, K.E 4727
Crowdy, S.H 4465
Cruz, L.U de la 1932
Cruz-Escoto, H 2965
CSIRO 2710
Cubbit, G.E.C 2876
Current, D 2448
D'Almeida, J.F.R 681
D'Arrigo, R.D 688
Dabral, B.G 064, 065, 066, 229, 230, 447, 526
Dabral, S.L 663, 876, 1435, 1436, 1693, 2877
Dabral, S.N 140, 1694, 1724, 2653
Dacanay, P 1845
Dadswell, H.E.Y 674
Dadwal, V.S 480, 1648, 2711, 2712, 2713, 2779
Dagar, J.C 231, 1165, 2363
Dah, Saw Eh 3897
Dahms, K.G 4005
Dai, Z.R 4473
Dal Fabbro, I.M 1454
Damale, D.N 1437
Damle, K 2714
Danaatmadja, O 1846
Dandge, A.S 4431
Dangwal, M.N 4202
Danhof, G.N 2054, 2055
Daniel, M 2688
Daquinta, M 1695, 1696, 1697, 1698
Dara, S.D 4178
Daradi, R.B 2364
Darmono, R 1438, 1699
Daryono, H 123, 2638
Das Gupta S.R 3128
Das, A 4667
Das, A.K 576
Das, A.P 124
Das, D.K 4105
Das, G 1439
Das, K 427
Das, K.K 3486, 4723
Das, M 232, 3326
Das, N.R 4474
Das, P.K 249, 250, 303, 364, 481
Das, S 1480, 3327
Das, S.N 3042
Dasappa 1275, 1619
Dasog, G.S 266, 421
Datar, D.S 4442, 4443
Date, G.P 1700
Datta, M 233, 234, 3328
Datta, R.C 1269
Datta, R.N 1353
Datta, S.K 4314
Dattaraja, H.S 2105
Dauget, J.M 2365
Dave, Y.S 699, 4106, 4136
David, B.V 2878, 3202
David, P.M.M 2962, 2963, 3158, 3159, 3160, 3161
Davidson, J 877, 912
Davidson, R.W 4301
Davis, L.C 1276
Davis, P.W 235

Dawkins, C.G.E 1277, 2366, 2879
Dawkins, H.C 125
Dawson, M.D 085
Dayal, R 3763
De Milde, R.A.J 3329
De Patel, K.V 4625
De Silva, D 4323
De'ath, C 3898
De, B.C 4547
De, H.B 265
De, R.N 2367, 4006
Deb, D.B 1077
Decamps, A 2501
Dechamps, R 4097
Deeparaj, B 2828, 2928
Deepu, J.K 428
Degbey, E.K 3652
Dehari, B 138
Dejong, J.C 4386
Delaunay, J 878, 879
Delgado, D 158
Dembner, S.A 2056
Denoga, A 1440
Denoga, N 1441
Dent, T.V 1442
Department of Forest Research, Nigeria 4007
Derksen, A.M 2743
Desai, B.K 2425, 3436
Desai, J.L 681
Desai, M.H 3145
Desch, H.E 4008
Descos, J 4666
Deshkar, A.M 4178
Deshmukh, A.P 3778
Deshpande, M.D 1297
Deshpande, V.P 2961
Dev, I 4199
Devaiah, P.K 3454
Devall, M.S 721
Devar, K.V 332, 333, 334, 335, 450, 451, 501, 1661, 2319
Devar, T.A.M 880
Devaraj, P 2438
Deventer, A.J van 1847, 2057, 2368, 2502, 2503, 2560, 2675, 3330, 3331
Devi, G.A.S 4315
Devi, R.K.S 4315
Devi, Y.S 1701
Devois, J 1078
Devoto, F.E 1079
Devraj, P 513
Dey, H.B 2290
Dhage, A.B 1730
Dhamodaran, T.K 4089, 4090, 4091, 4092, 4164, 4165, 4166, 4190, 4672
Dhanarajan, G 2880
Dhand, V 581
Dhanda, R.S 2369
Dhanmanonda, P 236, 525, 1278
Dhar, B.L 237, 238, 239, 240, 401
Dhar, P.P 482
Dhareshwar, S.S 1279, 2058
Dharmalingam, C 609, 1443, 1508, 1509, 1510, 1511, 1512, 1513, 1514
Dharmaswamy, S.S 1450, 2582
Dharmcharee, B 4179
Dharncaai, P 1702
Dhiman, K.R 234
Dhiman, R.C 3443
Dhotekar, U.P 960
Dhruva, B 1762
Dhuria, S.S 1925, 2262
Dhyansagar, V.R 1444
Dickey, E.E 4387
Dickinson, F.E 4009
Dietrichs, H.H 4054, 4351, 4358, 4359, 4360
Diggelen, C.H.P.C.van 4626
Dijkmans, M.A.F 2504, 2505
Dilip Kumar, P.J 028
Dimmel, D.R 606, 4727
Dimri, B.M 241, 271, 272, 273
Ding, J.Y 4180
Diniz, N.N 1422
Divekar, M.V 1848
Dixit, R.K 3520
Dixon, M 642
Djaban Tinambunan 3952
Djuwantoka 151
Dobhal, P.C 4327
Doh, G.H 4714
Dokania, L.N 4668
Dommergues, Y 1333, 3741, 4627
Dommers 2600
Don Pedro, K.N 4475
Donaldson, L.A 4107
Dontri, S.I 1445, 1446
Doo, S.C 2715
Doorn, A van 2506, 3653, 3899
Doorn, Z van 2059, 2060, 2061, 2507, 3654, 3655
Dorman, K.W 1048
Dorval, A 3035
Doungpet, M 4181
Draaisma, C.L.M 3332, 3656, 3657, 4628
Drechsel, P 088, 242, 243, 256, 582, 3582
Drees, E.M 1849, 2062, 2280, 2370
Duangratana, K 1447
Duarte-Casanova, A 2965
Dubey, R.K 1280
Dubey, Y.M 4432
Dubreuil, J 1080
Dulhoste, R 1034
Dulsalam 2508
Dun, G.S 2881
Dunne, T 527
Dupuy, B 1184, 1850, 2063, 2365, 3333
Durai, A 823
Durairaj, S 2828
Duran, P.J.A 4632
Durand, P.Y 4080, 4182
Durga, V.V.K 483
Dusane, D 4412
Dutt, S 4316
Dutta, N 4720, 4721
Duyfjes, J.J 3658, 3900, 4766
Dwiprabowow, H 3951
Dziobek, K 4236
Eadkeo, K 3265
Eappen, T 427
Easa, P.S 4094
Ebdon, P 4728
Eckert 1851
Eckstein, D 4130
Edelman, C.H 244
Edie A.G 2064
Edwardes, S.M 4476
Edwards, J.P 2882
Effendi, R.M 3566, 3567, 3811
Egenti, L.C 813, 814, 881, 882, 883, 1281
Egunjobi, J.K 414, 2181
Eidmann, F.E 126, 753, 1448, 1449, 1620, 2371
Eiumnoh, A 2358
Ekanade, O 167
Ekeke, B.A 2000
El Osta, M.L.M 4183
Elias, M 4317
Eligon, A 4184
Ellis, E.V 2509
Elmendorf, A 4669
Elsenbeer, H 527
Eluwa, M.C 2883
Emmanuel, C.J.S.K 708, 710, 884, 885, 1006, 1401, 1450, 1568, 1621
Encinas, O 4540
Endean, F 1842
Endom, W 2510, 4398
Enters, T 3659
Escalona, M 1695, 1696, 1697, 1698
Essenburg, J.F.W 1282
Estevez, M. J.E 1521
Estlander, T 583
Esuruoso, O.F 2753
Etejere, E.O 1398, 1399
Etuk, E.I 2639

Eungwijarnpanya, S 2884, 3021, 3146, 3203
Evans, H.F 3190
Evans, P.D 4653
Evers, J 3660
Eze, E.B 067
Ezenwa, M.I.S 245
Fabiyi, A 057
Fagbenro, J.A 2281
Faiqoh, M.N 484
Faix, O 590, 4318
Fanani, Z 3661
Fanning, E 153, 2678
FAO 029, 156, 755, 756, 886, 1185, 1186, 1283, 1451, 1452, 1852, 1853, 2065, 3233, 3662, 3663, 3664, 3665, 3666, 3667, 3668, 3669, 3818, 3819, 3820, 3821, 3822, 3901, 3902, 3903, 3904, 4010, 4580, 4581, 4582, 4583, 4584, 4585, 4586, 4587, 4588, 4589, 4590, 4591, 4629, 4630, 4767, 4768, 4769, 4770, 4771
Farooq, S.A 1778
Farooqui, U.M 2287, 2288, 2293
Farrer, R.P 1187
Fasehun, F.E 642, 684, 716
Fattah, H.A 3864
Faulkner, R 908
Fawole, M.O 1399
Fazlul Hoque, A.K.M 528
Feng, C.L 2482
Ferguson, J 1453
Ferguson, J.H.A 2885, 3234, 3334, 3335, 3336, 3337, 3338, 4011
Ferlin, G 068, 2066
Fernandes, A 4108
Fernandez, E.E 682, 1703, 2886, 2887
Fernando, S.N.U 1622, 2282, 2888
Ferraz AC de, O 1454
Feungchan, S 1854
Finegan, B 158
Firdaus, A.Ch 1855
Fischer, C.E.C 555, 2577, 2601, 3339
Fischer, W.R 2602
Fisher, R.F 2395
Fletcher, T.B 2889
Florence, E.J.M 2627, 2689, 2698, 2750, 2773, 2774, 2775, 4462
Florence, L.M 415, 2603
Fluyt, P.C.M 246
Fock, W.H 3670
Foelster, H 264
Fonseca Gonzalez, W 2283
Fonseca, W 1929, 4622
Forest and Forest Products Research Institute, Japan 4185, 4186, 4319
Forest Department, Andhra Pradesh 089, 1623, 1704, 2067, 2284, 2890, 3671
Forest Department, Burma 1284, 2891, 2892, 2893, 2894, 3144, 3340, 4012, 4592
Forest Department, Coorg 1624, 2068
Forest Department, Fiji 1188
Forest Department, Kenya 1856
Forest Department, Madras 2069, 2372, 2373, 2640, 3672
Forest Department, Nigeria 1189, 1857, 1858
Forest Department, Papua and New Guinea 887, 1455
Forest Department, Sri Lanka 1081, 2070, 2071, 2285, 2676, 3341
Forest Department, Tongo 1082, 1083, 1190, 1191, 1456, 2072, 2641, 3235
Forest Department, Uttar Pradesh 3342
Forest Department, Vellore 2716
Forest Department, West Bengal 1625, 1859
Forest Department, Zanzibar 1860
Forest Products Research Board, London 2895, 4477, 4631
Forest Research in India and Burma 1285, 1286
Forest Research Institute, Dehra Dun 002, 757, 758, 759, 760, 1084, 1192, 1193, 1287, 1288, 1289, 1290, 1291, 1292, 1293, 1294, 2073, 2074, 2075, 2076, 2077, 2561, 2562, 2563, 2564, 2642, 3343, 3344, 3345, 3346, 4541
Forest Service, Bogor 3673
Forest Tree Improvement, Arboretet Hoersholm 888
Forestry and Forest Products Research Institute, Japan 4670
FORSPA, Bangkok 003, 3347
Foster, G.S 947
Foulkes, F 1295, 2078, 4013
Foulkes, G.F 556
Fox, J.M 2460
Francis, J.K 1148, 3559
Francis, K 458
Franco, W 294, 592, 2324, 2520
Fraser, H 1861
Freezaillah bin Che Yeom 247
Freitas, M.C.P.G de 4014
Friday, K.S 3348
Fuenttes, D 3424
Fujita, S 4187
Fujiwara, T 722
Fukuhara, Y 4671
Fukusaki, E 608
Furtado, J.I 537
Furukawa, I 4336
Fuwape, J.A 4433
Gabhane, V.V 290
Gadbail, V.M 1665
Gadkari, R.K 3518
Gaharwar, K.S 3310
Gaikwad, S.T 321, 377
Gaikwal, S.R 1461
Gaiser, H 4545
Gajaseni, J 2374, 2375, 2385, 2511
Gajre, B 4412
Galiana, A 1707
Gallant, M.N 3674, 3905, 4593
Galloway, G 2079, 3430, 3431, 3675
Gambetta, A 4478
Gamble, J.S 557, 1296, 4015
Gan, K.S 4209
Ganapathy, P.M 1085
Gandhi, M.R 2830
Gandhi, S.S 2896
Ganesan, V 829
Ganeshaiah, K.N 1086
Ganglo, J.C 127, 128, 3676
Gangopadhyay, G 1705
Gangopadhyay, P.B 3677
Gangopadhyay, S.B 1705
Gangopadhyay, S.K 248, 249, 250, 251
Gangstad, J 4297
Ganguly, S 515, 516
Ganguly, S.K 303
Ganigera, B.S 3024
Ganther, W.D 4188
Gara, R.I 1869
Garay, J.D.A 4632
Garay, V 1034
Garcia, C 1755, 4387
Garcia, C.J.R 1862, 2512
Gardner, J.C.M 2897, 2898, 2899
Gardner, J.R 3953
Garg, R.K 469
Garland, E.A 2080, 3678
Garthwaite, P.F 2900, 3145
Gartner, C 4772
Garudachellam, C.P 1457
Gavinlertvatana, P 1706, 1798
Gawande, S.R 2286
Gay, F.J 4470, 4471, 4472, 4515, 4516

Gaynar, D.G 594
Geary, T.F 1863
Geetha, S 1566
Geigel, F.B 416
Geiger, F 683
Gent, J.R.P 1087
George, A 3777
George, J 584, 4417, 4497, 4667
George, K 2643
George, M 058, 129, 252, 259, 322, 417, 1164, 2321, 2352, 2447
George, M.P 2660, 3679
George, S.J 3399
George, V.C 149
Gera, M 889, 2081
Gera, N 889, 2081
Gerhardt, U 4361
Ghaiglom, D 2901, 2902, 2903, 3038, 3039
Ghani, A.R.A 3723
Ghani, Q 253, 254
Ghare, D.K 255
Ghate, H 3043
Ghatge, R.D 2451
Ghati 4016
Ghei, V.N 1694
Ghorpade, B.R 2904
Ghosh, P.K 496
Ghosh, R.C 1458, 1864, 1865, 2082, 2083, 3349
Ghosh, S.K 2644, 2645, 2646, 2647, 2648, 2650, 4190
Ghosh, S.S 4000
Ghude, D.B 1297, 2905, 2909
Gibson, I.A.S 2717, 2718, 2755
Gidiman, J 892
Gilbert, G 1194, 3350
Ginoga, B 4189
Gintings, A.N 081, 203
Ginwal, H.S 1675
Gireesan, K 793, 823, 1770
Girolkar, A.K 418
Glaser, B 256
Glass, J.B 3906, 3907
Gleadow, F 2604
Gnanaharan, R 2649, 2650, 4190, 4577, 4672
Gnanambal, V.S 1566
Gogate, M.G 069, 761, 890, 891, 959, 1297, 1878, 2287, 2288, 2905, 2909, 3680, 4109
Goh, D 1708
Goh, D.K.S 892, 1707, 1752, 1753, 1754
Gokulpure, R.S 2906
Gomes, J.E 2406
Gong, M.Q 485
Gonggrijp, L 2376, 2377
Gonzales, De M.M 3611
Gonzales, L.L 3351
Gonzalez Daimiel, A.P 1500
Gonzalez, A 1586
Gonzalez, R.M 3352
Goot, T van der 2084
Gopal, M 893, 1459
Gopal, R 152
Gopi, K.C 3180
Gopikumar, K 585, 586, 966, 1460, 1609, 1658
Gopinath, A 3000
Gopinathan, S 509
Goswami, H 1709
Goswami, K.V 3681
Goto, T 4378, 4399
Gotoh, T 2907, 2908, 3146
Gottwald, H 4110
Gouveia, V.M 3353
Gowda, H.C.H 2719
Gowri, K.V 2378
Goyal, A.K 3354
Grace, J 642, 684
Grace, J.K 4479
Gradual, L 894
Grainger, A 3355
Gram, K 762
Granert, W.G 2379
Granskog, J.E 3829
Graudal, L 895, 1022
Gray, A.I 568
Gresser, E 4594
Grewal, J.S 1461
Grewal, P.S 587
Griffith, A.L 070, 257, 685, 1298, 1299, 1626, 1627, 1628, 2085, 2086, 2087, 2088, 2089, 2090, 2142, 2143, 3356
Griffoen, K 2720, 4320
Grohs, B.M 4480
Groof, G De 529
Gu, M.B 3204
Gua, B.E 1428, 4017
Gueneau, P 2578
Guerra-Rivero, C 2965
Guha, S.R.D 4729, 4730, 4731, 4732, 4733
Guinet, P 4521
Gujar, D 761, 891
Gujar, D.R 2909
Gulam Chand 258
Gulati, A.S 4268, 4419, 4602, 4603, 4673
Gulati, N 4550
Gunaga, R 815, 830, 897, 1036
Gunaga, R.P 664, 686, 763, 896, 900
Gunasekaran, T 2438
Gupta, A 3886
Gupta, A.C 071, 350, 614, 1132, 1300, 2294, 4328
Gupta, B.B 2275
Gupta, B.K 3068, 3205, 3206, 3223
Gupta, B.N 761, 801, 891, 970, 972, 1015, 1462, 1463, 3156, 3503
Gupta, C 427
Gupta, G.C 798
Gupta, G.N 252, 259, 322, 359, 360, 2091
Gupta, H.K 4249
Gupta, H.S 3682
Gupta, J.N 1464
Gupta, J.P 2910
Gupta, M 2092
Gupta, M.K 271, 272, 273, 274
Gupta, P.K 744, 1710, 1743, 4038
Gupta, R.C 2583, 2584, 4321, 4496, 4674, 4688, 4704
Gupta, R.K 2380
Gupta, R.S 257, 260, 261, 588, 589, 4111, 4734, 4750
Gupta, S 483, 660, 1701, 1705, 4432, 4735
Gupta, S.B 4421
Gupta, S.K 341, 4119
Gupta, S.R 083
Gupta, V.C 4736
Gupta, V.K 4156
Guru, R.D 4157
Gurumurthi, K 1725, 1800, 1801
Gurumurthy, S.B 486, 487
Gurumurti, K 071, 1764, 1765, 2320
Gusmailina 4437
Guwaldi, S.V 1866
Gyaw, U.O 3908
Gyi, K.K 3823
Gyima-Boadi, N 4048
Gyimah, A 1629
Habibullah Sahib, M 3357
Hadi, Y.S 3554, 4047
Hadimani, A.S 419
Hadipoernomo 072, 130, 2565, 2566
Haeruman, H 090, 091, 3358
Haffner, L.C 4737
Hai, Hato 2513
Haider, M.G 472
Haidery, A 3683
Haines, H.H 558
Haines, R.J 1711
Halimi, M.S 484
Hallan, S 776
Hamazaki, T 107
Hambananda, P 3684
Hamid, A 528

Hamilton, A.P.E 1301, 1867
Hamilton, J.D 262
Hamza, K.F.S 4112
Hamzah, Z 542, 764, 898, 2638, 3236, 3237, 3238, 3685
Hanapi, S 3034
Hansbrough, J.R 2721
Hansen, C.P 3549
Hansen, W 4400
Hanumantha, M 763, 830, 899, 900, 1036, 3024
Haque, M.S 530, 2289, 2381, 3686
Harada, Y 3075
Harahap, R.M.S 765, 766, 901, 975
Hardcastle, P 3687
Harding, L.O.B 3909
Hardjodarsono, M.S 1195, 4018
Hardjono, D 1712
Hardjosoediro, S 3688
Hardjowasono, M.S 754, 1465, 1466
Hardy, E 4481
Harley, K.L.S 2651, 2911
Harlow, C.M 3689
Harne, J.E.M 3359
Harnsongkhram, A 3690
Harsh, N.S.K 2722, 2723, 2724, 3149, 3150
Hart, H.M.J 1302, 2093, 2382, 2725
Hartono, W 766, 3954
Hartoyo 4738
Hartoyo, A.T 4108
Hasan Muharam, E 2553
Hase, H 263, 264
Hashim, M.N 3691
Hashim, R 629
Hashim, S 1868
Haslett, A.N 4019
Hassan, M.M 420, 2290
Hattori, Y 4389
Haupt, M 590
Hausen, B.M 4322
Hauxwell, T.A 2912, 3910
Hawksworth, F.G 2652
Hayashi, D 4675
Hazard, L 1755
Healey, S.P 1869
Hector, C 3623
Hedegart, T 767, 768, 769, 770, 771, 811, 816, 902, 903, 904, 905, 906, 907, 908, 1713, 1714, 1715, 1716, 1722, 1870, 2913
Hedlin, A.F 2884
Heekeren, M.A 4020
Hegde, G.T 2260
Hegde, H.G 2260
Hegde, M 1770
Helles, F 3911
Hellinga, G 591, 909, 2094, 2095, 2096, 3360
Hemmingson, J.A 4345
Hendaris, D 1871
Hendra, D 4437
Hengsdijk, H 3843
Heringa, P.K 030, 2383
Hernandez, R 294, 592, 2324
Herrera, B 092
Herrera, B.J.F 4162
Hertling, J.C.von 1088
Hess, R.W 4052
Hewetson, C.E 1089, 1090, 2605
Hidalgo, E 910
Higbee, E.C 1872
Higgins, N.C 4191
Higo, Y 1091
Hill, H.C 3692
Hilleanau 4021
Hillis, W.E 4113, 4323
Hinchiranant, S 4022
Hinde, R.J 153
Hirai, S 3606
Hirano, Y 4324
Hiremath, I.G 2961
Hiromu, K 4192
Hissink, L.A.G 3693, 3694
Hla, U.T 1303
Hlaing, C 1915
Ho, C.P 1936
Hoare, P 1873
Hobbins, R 3361
Hocking, D 2726, 2727, 2728, 2729, 2730
Hodge, W.E 1304
Hodgson, C.M 1467, 3695, 3696
Hofseus, C.C 3912
Hojendahl, K 4193, 4194
Hole, R.S 2097, 2514, 2914, 2915, 2916, 3362
Hollerwoger, F 3239, 3363
Holmes, C.H 911, 1468
Holtum, J.A.M 627
Homfray, C.K 1630, 2098
Hon, C.H 1874
Hon, L.Y 4401
Hong, K.J 4549
Hooker, J.D 559
Hooper, D 593
Hooper, E.D.M 687
Hopens 4023
Hopwood, S.F 3697, 3824
Hoque, M.A 3364
Hoque, S.M.S 265
Horne, J.E.M 2099
Hosagoudar, V.B 2731
Hosalli, R.B 1524
Hossain, A.T.M.E 265
Hossain, M.K 507, 1469
Hossain, M.M 3409
Hossain, S.M.Z 488, 489
Hosur, G.C 266, 421
Houaye, P 3825
Howard, A.L 4024
Howard, S.H 031, 560, 1470
Howcroft, N.H.S 877, 912
Howse, P.E 4528
Hsu, E.L 2855
Hsu, M.J 154
Htwe, U.M.M 032
Huang, L.S 1796
Huang, Z.Y 4473
Hue, N.V 4188
Hughes, C.E 913
Hughes, R 075
Hugo, V 3424
Huguet, L 4773
Huke, S.M 2460
Hukushima, Y 4445
Hulster, I.A de 004
Hung, L.B 1471, 3412
Hunshal, C.S 578, 579, 611
Husen, A 1717, 1718, 1719, 1720
Hussain, A.M.M 1631
Hussain, S 033
Hussain, S.J 4736
Hussain, T 1305
Hutacharern, C 222, 2871, 2917, 2918, 2919, 3021, 3146
Hutchins 2100
Hutchison, J.D 4184
Hutson, J.L 2920
Hwang, G.S 4402
Hwang, S.R 4665, 4676
Hyderi, S.A 3486
Iamchandra, H 3913
Ibbotson, B.R 3698
Iddi, S 2224
Idris, M.M 2515, 2516, 2517, 2518, 2546
Igboanugo, A.B.I 308
Ikeda, T 3021
Ikojo, H.A 267
Ilorkar, V.M 1092
Imam, S 4736
Imam, S.A 1196
Immink, D.H 4025, 4177, 4195
Imperial Forestry Institute 2732, 4196
Imperial Institute, London 4739
Indian Botanical Society, Baroda 1093
Indian Standards Institute, New Delhi 4595, 4596, 4597, 4677,

4678, 4679, 4680, 4681, 4682, 4683
Indira Devi, P 3699
Indira, E.P 817, 820, 860, 914, 915, 1038, 1472, 1473, 1474, 3298, 3605, 3982, 4197, 4198
Indrachanjra, P.K 2186
Inoue, H 4675
Insawadhi, S 1632
Intachat, J 2921, 2922, 2923, 3147, 3148
Intari, S.E 2924, 2925, 2926, 3097, 3207
Isenberg, I.H 4114
Isfiati, S 3365
Ishak, S 2491, 2541
Ishida, A 646
Iskandar, M.I 4692
Islam, A.T.M.N 265, 420
Islam, M.N 1643
Islam, M.R 2826
Islam, S.S 3366, 3367
Ismail, S 2276
Ismanto, A 4744
Ismuyatmono, Y 3845
Itnal, C.J 611
Ito, K 2436
IUFRO 916, 2101, 3368
Iwasa, M 646
Iyer, H.S 331
Iyer, K.R.V 3369
Iyppu, A.I 2102
Jackson, J.K 1094, 1633, 2291, 2311
Jackson, W.F 4482
Jacob, J.P 2927, 2928
Jacob, M.P 3700
Jacob, S 014
Jacoby, G.C Jr 688
Jadhav, B.B 594, 2292
Jadjuabsin, S 1721, 1722
Jafarsidik, Y 131
Jaffer, A.A 2728, 2729, 2730
Jagannathan, V 1710
Jagat Singh 1475, 1476
Jaijing, D 689
Jain, A 595, 596, 3052, 4483, 4484, 4485, 4507, 4508, 4509
Jain, C.S 3786
Jain, D.K 4321, 4674
Jain, J.C 4440
Jain, J.D 4432, 4673, 4711
Jain, N.C 2584, 4199, 4241, 4497, 4502, 4684, 4685, 4686, 4687, 4688, 4705, 4740
Jain, S 617, 4384
Jain, S.H 2314, 2315
Jain, S.K 4741
Jain, V.K 4200, 4201, 4202
Jairajpuri, M.S 506
Jaiswal, H.R 2414
Jaiswal, P.L 776
Jalali, S.K 3095
Jalil, P 1477, 1478, 1542, 1700
Jamaluddin 476, 480, 490, 517, 2567, 2573, 2711, 2712, 2713, 2779, 2780, 2781, 2990, 3037, 3212
Jambhale, N.D 1875
Jambulingam, R 1574
James, P.E 4397
Jana, C.K 315, 441, 4441
Jana, M.M 328, 1730, 1758, 1759
Jane, F.W 4115
Jangal, M 4026
Janmahasatien, S 724
Jansen, H.G.P 3843
Janssen, H.W 3701
Jaski, K.C 268, 2103, 2104
Jaspal, N.S 4752
Jattan, S.S 1015
Jauhari, M.B 4742
Jawtha 3702
Jayadev, T 3703
Jayamadhavan, A 597, 3525
Jayaraman, K 394, 2977, 3018, 3370, 3371, 3372, 3373, 3374, 3375, 3376, 3377, 3605, 3704, 3705
Jayasankar, S 917, 918, 1479
Jayson, E.A 157, 2677, 2684
Jen, I.A 3914
Jena, S.C 1884
Jenkin, R.N 269
Jenkins, R.K.B 153, 2678, 2679
Jensen, B 4333
Jenstch 3706
Jentzsch, H 4434
Jerez, M 3432, 3553, 3580, 3581
Jeyamala, M 270
Jha, M 1665, 2568, 3378, 3707
Jha, M.N 238, 239, 240, 271, 272, 273, 274, 275, 276
Jha, S 496
Jhilmit, S 045, 1197, 2360
Jia Lal 4306
Jiayu, B 3379
Jimenez, M 2384
Jinaporn, B 3380
Jingsungnern, P 277
Jnnes, C.A 3708
Jobiraj, T 821
Jocano, A.P 623
Joesoef, M 4689
Joeswopranjoto, S 278, 531
John, C.H 677, 2674
John, C.K 1723
John, R 2105
John, S.K 1424
Johnson, G.C 2875
Johnston, A 491
Johnston, D.R 4116
Jolanki, R 583
Jollye, H.C.B 2106
Jones, E.B.G 2771, 2772
Jones, N 913, 919, 920, 931, 1480, 1502, 3381
Jong, B.D 2606
Joo, R.W 3709
Jordan, C.F 2385, 2511
Jose, A.I 191, 192, 193, 194, 279, 464, 2459
Joseph, K.J 2929
Joseph, R.N 2993
Joshi, C.S 422, 423
Joshi, D.N 1682, 2275
Joshi, K.C 598, 2997, 3052, 3053, 3054, 3055, 3056, 3057, 3149, 3156, 3210, 3211, 4490, 4507, 4508, 4509, 4510
Joshi, M.D 690, 2386
Joshi, N 4410
Joshi, N.J 3710
Joshi, S.R 280
Joshi, V.S 2287, 2288, 2293, 3680
Josue, J 4611
Jouvanceau, J 2519
Joy, V.C 429
Jung, G 424
Jung, H.D 599
Jutte, S.M 4027
Kachhwaha, T.S 3240
Kadam, R.S 2658
Kadambi, K 093, 281, 921, 1306, 1307, 1308, 1724, 2107, 2108, 2653, 2930, 4117
Kader, R.A 156
Kadio, A 3834
Kadiri, M 2795
Kadita, H 4203
Kaewcharoen, M 282
Kaewkamnerd, W 1481
Kaewla-Iad, T 283, 1876
Kaewsingha, A 1482
Kafuku, K 4325
Kai, A.T 4184
Kaikini, D.S 643
Kaikini, N.S 1309, 1310
Kaitpraneet, W 284, 379, 382, 383, 468, 2323, 3382, 3528, 3542
Kajiyama, S.I 608
Kajornsrichon, S 692, 2239
Kakkar, S.S 4028, 4204
Kala, J.C 034
Kale, R.B 2109

Kalia, S 3057, 3149, 3150, 3151, 3152, 3165
Kalita, R.K 2654
Kallarackal, J 532, 2579, 2580, 2655, 2656
Kalshoven, L.G.E 492, 1483, 2569, 2733, 2832, 2931, 2932, 2933, 2934, 2935, 2936, 2937, 2938, 2939, 2940, 2941, 2942, 2943, 2944, 2945, 2946, 2947, 3153
Kama, M 493
Kamal 494
Kamal Naidu, M 2110
Kamala, B.S 285, 572, 4440
Kamalam, N.V 703
Kamalpur, V.R 2680
Kamil, H 1793
Kamil, R.N 4189, 4403
Kamizore, S 2735
Kammesheidt, L 2520
Kamra, S.K 1484, 1485, 1486, 1487
Kanakadurga, V.N 475
Kanazawa, H 4326, 4404, 4426
Kanchanarangsri, S 810
Kandya, A.K 1488, 3383, 3384, 4435
Kandya, S 1488
Kanerva, L 583
Kanga, A.N 3333
Kanjilal, U 561
Kannan, C.S 980
Kanninen, M 100, 1922, 2185, 2190, 3323, 3324, 3325, 3431, 3459, 4003, 4103
Kannur, S 602
Kant, S 132
Kanzaki, H 608, 4330
Kapoor, K.S 147
Kapoor, L.D 133
Kapoor, M.L 885
Kapoor, S.K 1634
Kapoor, S.L 133
Kapoor, S.N 4542, 4543, 4544
Kapp, G 2387
Kapp, G.B 2388
Karadge, B.A 2734, 2784
Karamohandani, K.P 4486
Karani, P.K 4029
Kardjowasono, M.S 2362
Kareemulla, K 2479
Karmacharya, S.B 644, 3385
Karnasudirdja, S 4690
Karnataka Forest Department 3241
Karnik, C.P 2607
Karnik, M.G 4327, 4328, 4722
Karnphanich, P 4691
Karsoedjono 4598
Kartasubrata, J 3711
Kartasubrata, Y 1877
Kartna, S 1311
Kartosoedarmo, M 3826
Karunakaran, C.K 005, 3386
Kasmudjo 4689
Katagal, R.D 2948, 2949, 2950, 2956
Katare, P 3129
Katwal, R.P.S 035, 1725
Kaufman, C.M 2111
Kaul, O.N 286, 350, 1131, 2294
Kaul, R.N 1878
Kaupenjohann, M 632, 2295
Kaur, K 4550
Kaushik, R.C 772, 2112
Kawabe, Y 2735
Kawada, T 4336
Kawamura, F 4329
Kawazu, K 608, 4330
Kawcharoen, K 4118
Kawelaiad, T 289
Kayarnkit, C 1489
Kayastha, B.P 1879
Keddy, C.V.K 2521
Kedharnath, S 677, 691, 773, 774, 775, 776, 777, 783, 922, 923, 924, 925, 926, 927, 1726, 1776, 1777, 2951, 4119, 4493, 4494
Keh, K 1880
Keiding, A.H 928
Keiding, H 562, 908, 929, 930, 931, 932, 933, 934, 935, 998, 1490, 1727, 1728, 1729, 4030
Keita, J.D 1198
Kelkar, S.P 690
Kelley, T.M 4205
Kemp, R.H 866, 932
Kendurkar, S.V 1730, 1731, 1742, 1758, 1759, 1760, 4038
Keng, C.L 1709
Kenjale, R.Y 221, 425, 600, 2292
Kennedy, R.W 4206
Kenny, J.S 3644
Keoboualapha, B 2441
Keogh, R.M 094, 1199, 3387, 3388, 3712, 3713, 3714, 4774
Kerala Forest Department 3715, 4775
Kerala Forest Research Institute, Peechi 006, 007, 936, 2952
Kerbert, H.J 287, 533, 778, 2113, 2389, 2390
Kermani, W.A 1095
Kermode, C.W.D 1200, 1312, 1313, 1314, 1315, 1316, 1317, 1318, 1319, 1320, 2114, 2391, 2392
Kertadikara, A.W.S 779, 780, 937
Kesarcodi, S.N 1321, 2115, 2116, 3827
Kesornsiri, K 3389
Keth, S.K 1881
Keylwerth, R 4207, 4436, 4545
Khali Aziz Hamzah 3390
Khalil, M.A.K 2117
Khan, A.F.M.K 3409
Khan, A.H 2736, 2737, 3154
Khan, A.R 3040, 3041
Khan, B.M 1469, 1743
Khan, H.R 2953
Khan, M.A.W 1132, 1360, 1361, 1882, 2738
Khan, M.S 2118
Khan, N 507
Khan, R.M 4331
Khan, S.K 232
Khan, S.N 2708
Khanal, B.K 1635
Khandwe, R 2296
Khaosaat, A 1732
Kharche, M.L 2119
Khare, A.K 536
Khare, D.K 288
Khare, P.K 255, 288, 1672, 3124, 3578
Kharkhong, S 1491
Khatri, J.H 1733
Khatri, P.K 147, 320, 354, 388, 389, 1092, 1577, 1670
Khayankit, Ch 1492
Khaziah, A.K 3716
Khedkar, M.H 1636, 1637, 1638
Khemnark, B 938
Khemnark, C 289, 382, 939, 2323, 2472, 3391, 3528
Khobragade, N 290
Khobragade, N.D 871
Khosla, P.K 4550
Khovanich, U 3955
Khuspe, S.S 1742, 1743, 2263, 4038
Kietchaiyakorn, W 2954
Kijker, S 036, 3155
Kikata, Y 4389
Kim, S.K 4714
King, B 4550
Kinhal, G.A 3717
Kinloch, D 1201
Kirchof, F 4031
Kirtikar, K.R 4743
Kishore, N 2297
Kittinanda, S.P 940, 941, 942, 943, 944, 945, 1322, 2608, 3392

Kittisattho, S 3956
Kivung, D 3393
Kjaer, E.D 692, 781, 818, 852, 853, 894, 895, 928, 946, 947, 948, 949, 950, 1022
Kjulanova, S 4348
Klaithong, P 3394
Klassen, A 626
Kliangpibool, N 074
Kliwon, S 4692
Kloot, N.H 4250
Knapp, A.B 4700
Knight, R.A.G 4546
Knoop, W.J 2681
Knudsen, A.B 057
Knudsen, F 1490
Kobashi, S 3661
Kobayashi, A 608, 4330
Kobayashi, S 1374
Kobayashi, T 2739
Kobe, K.A 4737
Koegh, R.M 4032
Koelmeyer, K.O 3828
Kohli, I.S 3786
Kohli, R.C 584, 4695
Koirala, B 1469
Kokou, K 4120
Kokutse, A.D 4120
Kolison, S.H, Jr 3829
Kolmert, A 095
Komarayati, S 4437, 4744
Komkris, T 2609
Komura, S 4671
Konar, J 601
Kondas, S 3718, 3719
Kondo, R 4324
Kongsaengthai, Ch 2120
Konig, A 951
Kools, J.F 2522
Koppel, C van de 4208
Koppen, Karl van 1096
Koppikar, H.T 2657
Koppikar, V.B 2393
Kori, D.C 624
Korihalli, S.H 134
Kortz, A 2121
Koshi, S 1493
Koshi, T 4353, 4556
Koshy, M.M 279
Koshy, M.P 819, 1038, 4493, 4494
Kosol, S 495
Kossou, D.K 2955
Kothekar, V.S 1444
Kotrange, H.R 960
Kotulai, J.R 2908
Kotwal, E.K 2570, 3720
Kotwal, P.C 155, 426, 952, 953
Kovilur, N.L 4431
Koyo, J.P 913
Kraenzel, M 4332
Kramer, F 1323, 1494
Kriek, W 1097
Krishna Murthy, A.V.R.G 008, 954, 1098, 1495, 1496, 3721
Krishna, A 602
Krishna, S 4438, 4439, 4745, 4751
Krishnabumrung, V 3722
Krishnakumar, A.K 427
Krishnakumar, N 034
Krishnamurthy, K.V 712, 713, 4144, 4145, 4146
Krishnan, R.V 4563
Krishnan, S.R 3434
Krishnankutty, C.N 915, 1474, 1639, 3373, 3915, 3916, 3917, 3918, 3919, 3920, 3921
Krishnapillay, B 037, 302, 1227, 1883, 2122, 3691, 3723
Krishnapillay, D.B 3395
Krishnaswamy, K.R 4642
Krishnaswamy, V.S 135, 136, 693, 1324, 2123, 2124, 2125, 2394
Kristensen, P 4333
Kristnabamrung, W 4693
Krogh, H.K 603
Kuang, B 956
Kuang, B.C 955, 992
Kuang, L.G 398
Kubler, H 2581
Kuchli, C 3724
Kudindhra, U 3396
Kuerkool, P 1640, 3397
Kuiper, L.C 3629
Kukadia, M.U 1733
Kukde, R.J 4746
Kukretee, S.P 238, 239
Kukreti, D.P 4747
Kulchararin, S 4033
Kulkarni, D.H 073, 096, 1325
Kulkarni, H.D 2582
Kulkarni, K.A 3117
Kulkarni, L.B 4748
Kulkarni, N 3156, 3211
Kulkarni, P.K 1907
Kulkarni, R 1670
Kulkarni, S 2740
Kulkarni, V.M 1730, 1758, 1759, 1760
Kulpracheep, Ch 1497
Kumar, A 069, 957, 958, 959, 1461, 1462, 1498, 2658, 4314
Kumar, A.N.A 3398
Kumar, A.V.S 3401
Kumar, B.M 428, 2395, 2630, 3399, 3400
Kumar, C.P.S 4694
Kumar, C.T.A 2949, 2950, 2956
Kumar, K.R 722
Kumar, M 2800
Kumar, N.S 3004
Kumar, P 518, 1675, 2863, 3063, 3064, 3400
Kumar, P.D 917, 3401
Kumar, P.J.D 3725, 3726, 3727
Kumar, P.K.V 3036
Kumar, S 4487
Kumar, S.S 2395
Kumar, U 1884
Kumar, V 960
Kumar, V.B 4695
Kumaran, S 1885
Kumaravelu, G 034, 038, 782, 858
Kumazaki, M 2477, 3565
Kunhi Krishnan, K.V 4776
Kunimoto, R.K 2651
Kunnan, L 3379
Kunsi, E.D 1886, 3922
Kunz, B 4480
Kuo, P.W 4716
Kurat, P 525
Kurdikeri, M.B 577, 578, 579, 2949, 2950
Kuruvilla, K 1099, 3458
Kurz, S 563
Kushalappa, C.M 2126
Kushalappa, K.A 534, 961, 1202, 1641, 2396, 3402
Kushalkar, R 1734
Kushari, D.P 601
Kusuma Suebsaeng 2127
Kutintara, U 1326
Kwe, T 2610
Kwye, T 4069
Kyaw Sein, U 2957
Kyaw Tint 3250
Kyaw, S 3830
Kyi, Maung 1203, 3403, 3728, 3729
Kyi, U 3404, 3405
Kyi, U Win 4639
Kyi, W 4069
Laan, E.van der 3406
Lacharoch, S 1499
Lahiri, A.K 124, 1735, 1736, 2397, 2398, 2399, 3407
Lakanavichian, S 2958
Lakshmikantham, D 783, 1777
Lakshminarayan, U 145
Lal, A.B 2128, 2129, 2400
Lal, J.B 3730
Lal, M 4246
Lal, P 054
Lal, R.B 761, 891, 970, 4509
Lalitha, H.C 4405
Lalji Prasad 2953
Lall, R.B 3151

Lalman 604, 3408
Lama, S.D 2450
Lamb, A.F.A 039, 2130, 2401, 3731, 3732, 3733
Lamb, G.N 4034
Lamba, G.S 1327, 1328
Laming, P.B 4049
Lampe, M 2131
Lan, M 1047
Lande, M.L 2132
Lane, D.A 784, 1100
Lanier, L 1887
Laothai, P 4648
Lapongan, J 2133, 3290
Lappi, J 3374
Lara, L.L 2959
Larp 1888
Larsen, A.B 895
Larsen, C.S 762, 785, 2134
Larson, B.C 2135
LaSalle, J 3194
Laskar, S 605
Latham, B 3923, 3924, 3925, 3926, 3927
Latif, M.A 1642, 1643, 3409, 4547
Lauridsen, E.B 097, 692, 908, 933, 934, 935, 948, 949, 1644
Laurie, M.V 291, 786, 787, 788, 962, 963, 1329, 1889, 1890, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2402, 3410
Lavrov, M.T 1101
Lawton, J.R 4121
Lay, K.J 4717
Laya P.Nair 2749
Leavasa, A 1895
Lecoche, D 4370
Ledoux, P 1102
Lee, C.L 4334
Lee, J.S 4548
Lee, S.S 2741
Lee, S.Y 3709
Lees, J.C 156
Leete, F.A 1330, 2144, 2403, 2404
Lefroy, H.M 2960
Leithoff, H 590, 4053
Lejoly, J 128, 3676
Lely, W.G 4488
Lemckert, D 3782
Lenstra, J.B 4386
Leokito, D 1712
Lepitre, C 2519
Letourneux, C 1891, 3734
Levingston, R 1892, 3735
Leyva, A 606
Lezcano, Y 1695, 1696, 1697, 1698
Li, Z.Q 3123
Liang, K.N 040, 485, 1501
Liao, K.F 2742, 4549
Lii, W.J 4335, 4696, 4697, 4698, 4699
Lim, C.M 623
Lim, S.C 4209
Limaye, V.D 4035, 4210, 4211, 4212, 4213, 4214, 4215, 4216, 4217, 4218, 4219, 4406, 4599, 4600, 4607, 4633
Lin, D.D 1737
Lin, J.L 4220
Lin, J.S 4569
Lin, M.P 955
Lin, R.J 4549
Lin, T.Y 3411
Linden, A van der 1500
Lindgren, D 636
Lindgren, P 2523
Lindsay, W.R 1331
Lingappa, S 2961
Liu, C.T 4335, 4696, 4697, 4698, 4699
Liu, S.H 3412
Liu, W.M 992, 1501
Liu, Y 2482
Livingstone, D 3157
Lizano, M.H.C 3413
Loekito, D 964
Loetsch, F 1103, 1893, 3242, 3243, 3244, 3245, 3246, 3736
Loganathan, J 2962, 2963, 2964, 3158, 3159, 3160, 3161
Lokmal, N 051, 965
Long, A 1332
Long, J.N 3400
Longwood, F.R 4036
Lopez 3414
Lopez Palacios, S 1894
Lopez, D.T 4284, 4401
Lopez-Castilla, R.A 2965
Lottie 2405
Louman, B 1895
Louppe, D 2408, 3743
Lowe, R.G 807, 1204, 2145, 2146, 2147, 3737
Lowrie, A.E 3738
Loyttyniemi, K 1896
Lu, L.H 2325
Lu, S.A 2482
Lu-Junpei 098
Luangjame, J 074
Lucante, C 4666
Lucas, E.B 4726
Luckins, C.Babu 966
Lugo, A.E 3415
Lugt, C.S 1897, 2148, 3739
Lujan, R 2388
Lukmandaru, G 4108
Luo, M.X 955
Luoma, J 137
Lushington, A.W 2149, 3831
Lushington, P.M 3416, 4037
Lust, N 3851
Lwin, K 1898
Lynch, T.B 3247
Ma, H.M 040
Macalpine, R.I 1738
Macedo, R.L.G 2406
Machacheep, Y 4221
Machek, L 2743, 2744
Mackenzie, J.A 1502
Mackenzie, J.M.D 2966
Madan, R.N 4757
Maden, M 4550
Madhavan Pillai, N 2682
Madiwalar, S.L 2153, 2407, 2418
Madoffe, S.S 967, 968, 1899
Madsen, E 645
Madzlan Hj. Ahmad 1936
Maerschalk, J de 2187
Maessen, P.P.T.M 1900
Maghembe, J.A 968
Mahadevan, N.P 823
Mahajan, A.G 1362
Mahajan, N.M 1269
Mahalaha, S.H 3740
Mahapatra, P 969, 1739
Mahapol, S 2150
Mahato, K.C 1460
Mahendra, A.K 3756
Maheswarappa, V 2745, 4489
Maheut, J 1333, 3741, 4627
Mahmud, A.W 3723
Mahobia, G.P 2967
Mahtolia, D.C 1740
Maimongkol, W 099
Maitland, V.K 2151, 3742
Maitre, H.F 3333
Maity, C.R 605
Maity, S.K 429
Majumdar, R.B 1371
Majumdar, S.G 605
Makonda, F.B.S 2224
Maldonado, E.D 2152
Maldonado, G 2408, 3743
Malende, Y.H 3417, 4067
Malik, N.K 2862, 4466
Malimbwi, R.E 2224
Mall, L.P 426
Mallet, B 892
Mallikarjuna, K 653
Malvaranta, P 4407
Maman, M.I 2524
Mammen, C 3418, 3523, 3605, 3744, 3745, 3796, 3832, 3833, 3838, 3839
Mammen, M 4398
Mamun, J 4570

Mandal, A.K 761, 789, 793, 800, 801, 871, 872, 891, 959, 970, 971, 972, 981, 1015, 1016, 1676, 1769, 1783, 3523, 3796
Mandal, S 607, 808, 809, 1683
Mang, W 4222
Mangundikoro, A 2525
Manhas, R.K 581
Mani, M.S 2968
Manickavasagam, S 3202
Manimuthu, L 1515
Manivachakam, P 2091, 2352
Manivanh, V 2441
Manjappa, K 2425, 3436
Manjunath, G.O 602
Manmuang, S 2478
Manna, M.C 496
Mannan, M.A 1503
Mannikar, N.D 357
Mannikeri, I.M 2306
Manning, D.E.B 694, 1334
Manoch, L 495
Manoharachary, C 475
Manoj Kumar 3699
Manonmani, V 1504
Manson, F.B 2611
Mansuri 1944
Mansyur, M 2539
Mapa, R.B 292
Maragatham, S 2964
Marawar, S.S 1802, 2346
Marcelino Montero, M 100
Marigoudra, R.M 2153
Marjoribanks, G.E 1335
Marquez, O 293, 294, 592, 2324
Marsden, E 1741
Marsden, R.E 3419
Marshall, R.C 2154, 2155, 2156
Marsoem, S.N 4108, 4389
Martawijaya, A 4551
Marten, K.D 2157
Martin, B 3834
Martin, B.E 1711
Martinez, H.A 1205
Martinez, H.H.A 1146
Maruyama, Y 646
Marwani, E 608, 4330
Mary, M.V 170, 171, 197, 430, 2336
Mascarenhas, A.F 1710, 1723, 1730, 1742, 1743, 1758, 4038
Mascarenhas, L.P 1505
Masilamani, P 609, 1443, 1506, 1507, 1508, 1509, 1510, 1511, 1512, 1513, 1514, 1515, 2298
Masilungan, V.A, et al 4749
Maslekar, A.R 3248
Mastura, M 3147, 3148
Masuko, H 2526
Mathauda, G.S 693, 973, 1781, 3420, 3421, 3746
Mathew, G 819, 820, 2969, 2970, 2971, 2972, 2973, 2974, 2975, 2976, 2977, 2978, 3000, 3012, 3020, 3162, 3163, 3208, 4493, 4494
Mathew, J 1516
Mathew, L 4122
Mathews, J.D 790, 926, 4119
Mathur, A.K 2409
Mathur, B.C 4732
Mathur, C.M 1104, 1105, 2158
Mathur, H.N 374
Mathur, K.B.L 009
Mathur, K.C 200
Mathur, R.N 2979, 2980, 2981, 2982, 2983, 2984, 3164
Mathur, R.S 3754
Mathur, V.P 1645, 1744
Matin, M.A 1646
Matos Gonzalez, E 2159
Matsumoto, K 1874, 2908
Matsumoto, Y 646, 647
Matsune, K 3075
Matta Machado, R 2375
Matte, D.B 290
Maun, M.M 2299
Maung Gale, U 1336, 1337
Maung, U.W 4634
Mauricio, J.R 3422
Maydell, H.J von 3957
Maziah, Z 2741, 2746
Mbakwe, H.N 1647
Mc-Couch, S.R 1029
McCarter, P.S 913
McCrie, C.M 2410
McDonald, A 4039
McDonald, T 2571
McGowan, J.C 2849
McGregor, A 3747
McIntosh, R 3748
McKerlie, J.E 3749
MeCrie, C.M 2411
Meekaew, P 974
Mehar Singh 3768
Mehendale, V.D 3750
Meher Homji, V.M 1106, 1153, 1154
Mehetre, S.S 2451
Mehrotra, M.D 1648, 2747, 2776, 2985
Mehta, U.V 3751
Meichsner, H 4545
Meier, D 590, 4318
Meikle, W.G 3022
Mein, A.J 2986, 2987, 3423
Meindersma, H.W 2683
Mejia Mesa, L.C 4162
Meka, E.Z 3752
Mekvichai, B 3958
Melchior, G.H 791
Mello, H do Amaral 1107, 1108
Memed, R 4692
Mendhe, S.N 4746
Mendonca, E.A.F de 1422
Mendoza, B 3424
Meniaud, J 1745, 1746, 1901, 4040
Menon, A.R.R 3012
Menon, K.D 2988, 2989, 4601
Menon, P.K.B 4123
Mensbruge, G de la 535, 1109, 1902, 2160
Merrick, M.J 4700
Merton, C.G 3928
Meshram, P.B 436, 2990, 2991, 3037, 3165, 3209, 3210, 3211, 3212, 4490
Metcalfe, J 2161
Methven, I.R 415, 2603
Meyer, W.L 175, 176, 343, 344, 345
Meyer, W.W 1487
Micski, J 3280
Miedler, K.A 2527
Mieke, S 2992
Mijers, W.N 1903, 1904
Milde, R de 2412
Militz, H 2744
Miller, A.D 3425
Miller, R 4297
Miller, W.A 3426
Millett, G.V 1338
Milward, R.C 1110
Minchin, A.A.F 2162
Ministry of Agricultural and Water Resources, Nigeria 1905
Ministry of Trade and Industry, Malaysia 3753
Mirchandani, T.K 1111, 2163
Mischra, S 4412
Mishra, G.P 119, 120, 224, 255, 288, 413, 445, 545, 546, 547, 651, 1349, 1672, 1747, 1748, 2993, 3469, 3578
Mishra, H.N 4635, 4636
Mishra, J 2413
Mishra, K 1747, 1748, 2300
Mishra, M 1517, 1518, 1749
Mishra, S.C 2994, 2995, 4491
Mishra, T.K 138, 365
Misra, A 604, 3408
Misra, A.K 616
Misra, D.N 3754
Misra, K.K 1554, 2414
Misra, K.N 3284, 3504
Misra, M.P 2996, 3143

Misra, R 1112
Misra, R.M 2659, 3072, 3073, 3166
Misra, S.C 3068
Mistry, S 1519
Mitarini, D 975
Mitchell, B.A 2748
Mitra, S.K 2528
Mitra, T.K 3755
Mittelman, A 2415
Miwa, K 3661
Mizra, N.M 3756
Mkilanya, P.M 976
Mlungwana, S.M 4331
Mobbs, E.C 3835
Modak, C.D 2768
Moeljodihardjo, G 1906
Mohammad Yousuf 2997
Mohan Kumar, B 2301, 3470
Mohan, A 1907
Mohan, E 145
Mohan, S 058, 259, 2091
Mohanadas, K 817, 819, 820, 2978, 2998, 2999, 3000, 3012, 3013, 3014, 3019, 3020, 3093, 3115, 3167, 3169, 3170, 3171, 3172, 3182, 3185, 3190, 3197, 4493, 4494
Mohanan, C 001, 497, 498, 1559, 1560, 2698, 2749, 2750, 2773, 2774, 2775
Mohanasundaram, M 3001, 3002
Mohandas, K 821, 2975, 3173
Mohanraj, P 3118
Mohanty, A.P 2164
Mohanty, S.C 801
Mohd Arshad, S 4284
Mohd Ghazali, H 571
Mohd Noor Mahat 1520, 3691
Mohd Shukari Midon 4715
Mohd Zaini Ujang 4715
Mohd Zaki Abdullah 1520
Mohmmad, G 1660
Mohr, E.C.J 295
Mohya, T 3427
Mokashi, V.K 3249
Moldenke, H.N 010
Momoh, Z.O 2751, 2752, 2753, 2754
Mon, A.A 1176
Mongia, A.D 231, 296, 297, 298
Moni, A.S 2165
Moni, G 2166
Moni, N.S 2660
Montagnini, F 1922, 2190
Montalvo, J.M 2384
Montero, N.C 1521
Monteuuis, O 892, 1123, 1685, 1686, 1708, 1750, 1751, 1752, 1753, 1754, 1755, 3620
Mooksombat, S 792
Moonrasarn, S 3757, 3929
Moor, H.W 3428
Moore, D 1908, 2167, 4637
Moore, T 4332
Mora Garces, A 3429, 3432
Moraes J.M de 527
Morales, N 910
Morataya, R 1946, 3430, 3431
Moredo, C.C Jr 4336
Morehead, F.T 041
Morel, J 1339
Morellet, J 101
Moreno Beltran, H 2572
Moreno, P.P.A 4632
Moreno, V 910
Moret, A.Y 3422, 3429, 3432, 3553
Morikawa, Y 646
Morishita, F 4389
Moss, R.P 1127
Moss, S.G 1522
Mottonen, V 4407
Moureaux, C 499
Moya, R 4124, 4223
Mridha, M.A.U 482, 507
Msanga, H.P 1523
Muchjacheep, Y 4224
Mueller Darss, H 2168, 2169
Mueller, L.G 1909
Mugasha, A.G 219
Muhammed, E 3838
Mujumdar, R.B 1340, 1372
Mukadai, J 4203
Mukdasanit, B 4225
Mukewar, A.M 977, 1802
Mukherjee, B.B 660, 1701
Mukherjee, K.K 1705
Mukherji, H.K 4226, 4227, 4228, 4229
Mukhtar, A 4492
Mukudai, J 4192
Mulard, M 1910
Mulder, J.L 2755
Mullin, T.J 636
Mundt, T 1756
Mungkorndin, S 3433, 3836
Muniswami, K.P 978
Munz, W 4408, 4638
Muraleedharan, P.K 2661
Murali, K.S 2260, 3003
Murali, V 1004, 1005
Muralidharan, E.M 1757, 2261
Murchison, H.G 176, 344, 345, 3449
Murillo, O 979, 2170, 2205
Murphy, J.O 723, 726
Murphy, S.T 3194
Murray, C.H 2612, 2662
Murthi, S 1329
Murthy, M.S 299
Murthy, V.K 3255
Murti, S.S.N 1004, 1005, 1656
Murty, E.S 3520
Murty, L.S.V 2613
Murugan, A 446
Murugan, K 3004
Murugesan, S 2928
Murugesh, M 300, 1649, 3434, 3435
Mustanoja, K.J 2198
Mutanal, S.M 1524, 2302, 2303, 2304, 2305, 2306, 2307, 2407, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423
Muthanna, M.A 1329
Muthukrishnan, R 3047, 3219
Muttiah, S 1525, 3213
Mwalyosi, R 075
Myers, W.N 301
Myint Kyu Pe 4041
Myint Tin 3250, 3251
Myint, U Thein 4639
Mythili, S 225
N'Guessan, A 2365
Na Lampoon, A 1650
NABARD 2424
Naco, M.F 3252
Nadagouda, V.B 2425, 3436
Nadagoudar, B.S 1524, 2302, 2303, 2304, 2306, 2307, 2407, 2416, 2417, 2419, 2421, 2422, 2423
Nadgauda, R.S 1723, 1731, 1743, 1758, 1759, 1760
Nadgir, A.L 1710
Nadiar, S 4778
Nagarajan, B 793, 823, 980, 981, 982, 1035, 3523, 3796
Nagarajan, N 509
Nagaraju, S 1778, 4708
Nagaveni, H.C 2268
Nagdev, D.P 3837
Nagesh Prabhu, H 042, 664
Nagle, W 4701, 4702
Naha, S.K 500
Naidenova, T.S 4427
Naidu, C.V 540, 652, 653, 654
Naidu, K.K 1911
Naik, M.I 3030, 3031, 3178, 3179
Naik, M.L 418, 431
Naik, S.T 501, 2719, 2745, 4489
Naing, U.K.K 3959
Nair, C.T.S 3437, 3838, 3839, 3840

Nair, K.K 4777
Nair, K.R 4227, 4228, 4229
Nair, K.S.S 2978, 3005, 3006, 3007, 3008, 3009, 3010, 3011, 3012, 3013, 3014, 3015, 3016, 3017, 3018, 3019, 3020, 3091, 3115, 3168, 3169, 3170, 3171, 3172, 3173, 3182, 3214, 3215, 3221, 3526, 4493, 4494
Nair, M.N.B 4125
Nair, P.N 1341, 2426, 2663, 3758
Nair, P.V 157, 2684
Nair, V.R.K 4640
Naithani, S 374
Najib Lotfy, A 302
Nakagami, T 4326
Nakama, E 3075
Nakamura, K 610, 3021, 3075
Nakashima, K 2427
Nakashima, T 3021
Nakatsuka, T 4334
Namasivayam, M 4641
Namta, B 138
Nanda, J.R 4642
Nanda, K.K 648, 1761
Nandakumar, U.N 217, 218, 3375, 3605
Nansen, C 3022
Napompeth, B 2958
Naraballobh, V 2609
Narasimhan, R 1762, 4710
Narayan Nambiyar, V.P 4385
Narayana, A 3520
Narayanamurti, D 2529, 2583, 2584, 4042, 4043, 4126, 4230, 4231, 4232, 4233, 4337, 4338, 4339, 4340, 4341, 4342, 4343, 4409, 4495, 4496, 4497, 4498, 4643, 4703, 4704, 4705
Narayanan, C 982, 1013
Narendran, T.C 821
Narula, A 617
Nashikkar, V.J 2277
Nasoetion, A.H 3512
Nastor, M 3289
Natalia, P.D 396
Nataraja, K.N 3438
Natawiria, D 3023
Nath, B 3841
Nath, S 199, 249, 250, 251, 303, 364, 369, 481, 625
Nath, V 2723
National Taiwan University 3439
Nautiyal, S 147, 1763, 1764, 1765
Nayak, B.G 3024
Nayak, P.K 3440
Nayar, S.L 4725
Nearn, W.T 4344
Neelay, V.R 1651, 3216
Neergaard, P 2756
Negi, D.D.S 4374
Negi, G.C.S 649
Negi, G.S 3441, 4234, 4269, 4270
Negi, J.D.S 376, 581, 2294, 3442
Negi, K.S 1651, 3216
Negi, M.S 3443, 3444, 3770
Negi, S.S 4044
Negi, Y.S 4157
Nema, A.G 536, 2757
Neo, S.L 4375
Neumann, A 102, 3445
Neumann, A.J 102, 1839, 2171, 3445
Newman, H.L 1766
Newman, R.H 4345
Newman, S.M 2440
Newton, B.E 527
Ngampongsai, C 650
Nghia, C.Q 043
Ngulube, M 1526, 1527
Nguyen Hoang Nghia 3446
Nguyen Khac Hieu 076
Nguyen Thi Thuyet Hoa 396
Nguyen, N.K 2875
Nicholson, D.I 1912
Nicholson, J.W 1342
Nicodemus, A 823, 980, 981, 982, 1013, 1024, 1035, 4143
Nicolle, J 4371
Niemmich 3842
Nieuwenhuyse, A 3843
Nik Zanariah, N.H 1964
Nikhra, K.M 2786
Nilaubol, M.L.A 4346
Niloufari, P 3930
Nimitsiriwat, S 3447
Nina Mindawati 1113
Ninin, P 2585
Niranjan, P 665
Nisbet, J 1114, 1528, 2530, 3448, 4045
Nisharaj, S 432
Nishida, M 2308
Niskanen, A 1913, 3759
Nitoda, T 608, 4330
Nobashi, K 4326
Nobles, R.W 139, 2040
Nobuchi, T 724, 2308, 4127
Noerhadi, E 1767
Nokoe, S 3253
Noltee, A.C 1302, 2172
Nonhare, B.P 3844
Noor Mahat, M 1964, 3723
Noor, H.M 304, 2173
Nopsuwan, P 4046
Nor Aini, A.S 484
Norini, H 3723
Norlia, B 983
Norman, J.C 1529
Norwati, A 983
Nungchim, A 358
Nunifu, T.K 3449
Nurhayati, T 4347
Nussbaum, R.M 4552
Nuthan, D 984
Nwaigbo, L.C 2000
Nwoboshi, L.C 305, 306, 307, 1652, 2174, 2309, 2310, 3450
Nynetr, M 2175
Oates, C.G 495
Ocampo, O.P.M 568
Odeyinde, M.A 985, 2754, 2758
Odu, C.T.I 502
Oduwaiye, E.A 986
Oever, H.Ten 1115, 1343, 1344, 1345, 1653, 1914, 2176, 2177, 2614
Offi, K 3834
Ogbe, G.A.E 1116, 2615
Ogigirigi, M.A 308
Oguntala, A.B 2616
Ohene Coffie, F 1654
Ohn Maung 2178
Ohsaki, T 4548
Ohta, S 725
Ojechomon, O.O 2428
Ojo, G.O.A 987, 2311
Oka, A.G 988
Okada, N 2308
Okali, D.U.U 537, 684, 716, 2468, 2469
Okanishi, T 4719
Okoegwale, E.E 503
Okojie, L.O 309
Okoro, S.P.A 310, 311
Okuyama, T 3554, 4047
OL, J.F 2429
Ola-Adams, B.A 473, 2179, 2180, 2181, 3451, 3452
Ole Meiludie, R.E.L 2227
Oliveira, T.K de 2406
Oliver, J.W 1117, 1530, 3453
Olorunisola, A.O 4644
Olson, O.H 4387
Oluwalana, S.A 3960
Omoyiola, B 989
Ona, A 1895
Ong, T.H 037
Onishi, H 4399
Onkarappa, S 2956
Oo, M.T 1915
Oohata, S 2436, 3474
Oommachan, M 1135
Orlandi, E 4478
Orman, H.R 4235
Osagie, C.O 310, 311
Osathaphant, P 4761

Osemeobo, G.J 2430
Osman, K.T 530, 2381
Osmaston, L.S 1531, 2431
Osonubi, O 695
Osorio, R 1916
Osumi, Y 312
Osundina, M.A 695
Oteng-Amoako, A.A 044, 4048
Ouseph, K.P 3760
Owens, J.N 822, 826, 827, 828, 990, 991
Oykkonen, M 4407
Oza, M.P 3254, 3260, 3454, 3520
Pagar, P.C 290
Pahlitzsca, G 2531, 4236
Pais, A 2685
Pajni, H.R 2896
Pakdee, P 1532
Pakpahan, A 3845
Pal, D.K 369
Pal, M 1518, 1717, 1718, 1719, 1720, 1740, 1749, 1768
Pal, N 666
Pal, R 3054, 4757
Palanisamy, K 1769, 1770, 1771
Palmberg, C.M 746, 747
Palmer, J.G 726
Palupi, E.R 822, 990, 991
Pan, Y.F 992, 1501
Panayotov, P 4348
Panburana, N 525
Panda, A 433
Pandalai, R.C 217, 218, 2261
Pande, A 2759
Pande, J.K 696, 697
Pande, P 275
Pande, P.K 313, 434, 435, 436, 437, 438, 439, 440, 459, 1155, 1156, 1346
Pande, S.K 104, 229, 447
Pande, V.K 2967
Pandey, C.N 4410, 4411, 4440
Pandey, D 011, 3455, 3456, 3457, 3606
Pandey, K.K 4349
Pandey, K.N 4422
Pandey, R 274
Pandey, R.K 1159
Pandey, V.N 3504
Pandeya, S.C 1118, 2432, 3458
Pandit, A 052
Pandit, B.R 314, 315, 441, 442, 443, 538, 1157, 4441
Panggabean, G 396
Panicker, V.R 316
Panjamanondh, W 1533
Pankaj Khullar 012, 1763
Pant, B.C 4414, 4422
Pant, D.C 2762
Pant, G.B 722
Pant, H.C 4497
Pant, K 052
Pant, N.C 1676, 3152, 3601, 4483
Pant, P.C 4729
Pant, S.C 4529
Paoprachak, P 317
Paosujja, R 993, 1772
Parabia, M.H 1163
Paramathma, M 994
Parameswaran, N 4110, 4128
Parameswarappa, S 3761, 3762, 3788
Paranjpe, S.V 2263
Parashar, K.K 2262
Paratasilpin, T 1677
Pardasani, R.T 598
Parde, J 1119
Parihar, A.K.S 330
Parihar, D.R 4499
Pariswad, B.S 3254
Park, W.K 731, 732
Parker, R.N 1329
Parkes, W 4500
Paroha, S 504, 1660
Parresol, B.R 721
Parry, M.S 1917
Parthasarathi, K 285, 572, 1003
Parthiban, K.T 300, 318, 319, 505, 994, 1566
Parvathappa, H.C 419
Patanapongsa, N 1873
Patel, J.D 4133
Patel, R.I 2182
Patel, S 329
Patel, V.J 1918
Paterl, F 2463
Pathak, N.K.R 619
Pathak, S.C 2990, 3212
Pathak, S.K 463
Pathak, T.C 258
Pati, D.P 474
Patil, A.K 3217
Patil, A.P 3217
Patil, B.N 290
Patil, B.R 3217
Patil, B.V 3025, 3026, 3027, 3028, 3029, 3174, 3175, 3176, 3177
Patil, C.R 2785
Patil, C.V 2425, 3436
Patil, F.B 1875
Patil, M.M 1875
Patil, P.T 3217
Patil, R.H 611
Patil, S.A 578, 579
Patil, S.C 1875
Patil, S.J 1524, 2416
Patil, S.K 3024
Patil, S.P 2904
Patil, S.U 3030, 3031, 3178, 3179
Patil, Y.P 4412
Patle, B.R 588, 589, 4734, 4750, 4760
Patley, R.K 1690
Patra, A.K 2991
Pattanath, P.G 1459, 1463
Patterson, D.G 4237
Paulsamy, S 432, 446
Pavanaram, S.K 4350
Pawar, C.S 3032, 3033
Pawsey, R.G 2760
Pearce, K.G 3034
Pearson, R.S 1534, 1535, 4238, 4239, 4240, 4553
Pedroso, L.M 1120, 1919
Peet, C 1121
Pegler, D.N 2761
Pelmer, R.W.V 1536
Peluso, N.L 3846
Peng, S.F 2742, 4549
Penteado, S.R 1454
Pentsil, M.Y 1199
Peregrine, D.J 2866
Perera, W.R.H 995, 1537, 1920, 2183, 2184
Peres Filho, O 3035
Perez, C.L.D 3459
Perez, G.C.M 3218
Perez, I 2809
Perez, L.D 2185
Periera, W.E 1921
Perla, J 158
Perlis, A 2056
Persson, A 996, 997
Petekhandah, S 3460
Petmark, P 3461
Petty 3847
Phang-Sono 3462
Pharasi, S.C 327
Phillips, G.B 3463
Phong-Amphai, S 3464
Phothisaro, C 1538
Phrombupha, A.S 2186
Phromsilp, V 105
Phukphan, S 3465
Phulari, M.M 1406
Piam-a-roon, A 4648
Pianhanurak, P 1773
Piedrahita, E 1539
Pieters, A 2187
Pillai, R.D 2188, 2189
Pillai, S.R.M 3180
Pinol, A.A 3466
Pinyopusarek, K 998
Pinzon Florian, O.P 2572
Piot, J 999
Piotto, D 1922, 2190
Pipitvitaya, S 1433

Pitcher, J 1048
Piyapan, P 863, 1773
Plasschaert, E.K 2191
Plodpleaw, A 077
Plonczak, M 2520
Poa, D.N 1428
Poddar, R 1705
Poedjoraharjo, D.S 3864
Polato, R 4049
Polwicha, P 2872
Pongpangan, S 1540
Pongsopha, Ch 2192, 3467
Ponoy, B 1411
Popham, F.J 4501
Popham, S 1923
Porapakkharm, Ch 2193
Porter, H.J 1347, 3848
Potty, S.N 427
Potvin, C 4317, 4332
Pound, J 4706
Poupard, C 1755
Pousugg, R.C 1541
Powell, W.S 3468
Praasterink, H.C 2617
Prabhakar, A.S 2303, 2304, 2305, 2306, 2307, 2417, 2418, 2419, 2420, 2421, 2422, 2423
Prabhu, H.N 3849
Prachim Suksileung 1000
Pradeepkumar, G 1158
Pradhan, I.P 444, 3763
Prahasto, H 2433, 3961
Prakasan, C.B 3036
Prakong Intrachandra 2194
Pramono, S 612
Prasad, A 147, 320, 354, 388
Prasad, B.N 2529, 4126, 4241, 4502, 4707
Prasad, H 366
Prasad, J 321
Prasad, K.G 200, 220, 259, 322, 327, 359, 360, 368, 370, 371, 1020
Prasad, R 078, 120, 224, 413, 445, 651, 1159, 1349, 1542, 1924, 1925, 2195, 2196, 2312, 2434, 2573, 3037, 3469
Prasad, R.C 1348
Prasad, R.S.R 3850
Prasad, U.N 2413
Prasad, V 2762
Prasannakumar, P.G 315, 441
Prasoon Kumar 3470
Prat, D 779, 780, 937
Prathapasenan, G 1158
Pratheesh, V.S 3699
Prathummanee, Ch 323
Pratiwi 3851
Prawira, S.A 2668
Prawotosoedarmo, S 794, 1001
Predjorahardjo 2532
Prem Nath 065, 066
Premrasme, T 3038, 3039, 4351, 4503
Prertiwarakul, L 3471
Preston, R.D 4101
Pricha Dhanm Anonda 324
Pringle, A.M 3764
Priya, P.B 727, 728, 3472, 3983, 4093, 4129
Proctor, J 466
Prommool, S 3473
Pruthi, K.S 4645
Puangchit, L 1374
Pullman, G.S 606, 4727
Puls, J 590
Pumijumnong, N 729, 730, 731, 732, 4130
Punde, A.B 1543
Puntambekar, S.V 4751
Puranik, C.P 3378
Puri, G.S 136, 140, 325, 613, 614, 1122
Puri, S 1787, 2435
Puri, S.K 616
Puri, Y.N 3074, 4458, 4504
Purkayastha, S.K 1002, 4131, 4132, 4134, 4242
Purnama, B.M 3961
Purohit, A.N 1761
Purushotham, A 4043, 4352, 4554, 4555
Purwadaria, S 4188
Purwadi 2666
Purwanto, I 539
Purwanto, R.H 2436, 3474
Puth, M 4360
Puttarangappa, S 2852
Qiao, G.M 1047
Quint, M.P.L 1206, 1350, 4050
Qureshi, I.M 079, 326, 1269, 1351, 1352, 2197, 2664
Rabindra, R.J 3181
Rachadi 2437
Radder, G.D 2425
Radhamani, A 1024
Radomiljac, A 3962
Radomiljac, A.M 4096
Raets, G.H 1926
Raghavan, M.S 103, 3475
Raghavendra, B.G 4708
Raghubanshi, A.S 356
Rahman, A 2198, 3765, 3852, 3931
Rahman, A.H.M.M 1774
Rahman, M.F 506
Rahman, M.M 2665
Rahman, M.S 500, 507
Rai, A 2722
Rai, A.M 3520
Rai, B 1075
Rai, B.K 2722
Rai, L 1353
Rai, P.A 4752
Rai, P.N 2414
Rai, P.S 3117
Rai, R.S.V 300, 318, 319, 505, 1649, 3435
Rai, S.N 285, 572, 1003, 2688, 3932
Raichur, R.G 501
Raigosa, J 2313, 4175
Raina, A.K 200, 327
Raizada, A 376
Raizada, M.B 777, 1161
Rajak, R.C 2786, 3040, 3041, 3129, 3184
Rajamuthukrishnan 3098
Rajan, S.K 508
Rajarajan, A 2199
Rajarishi, R 2828
Rajeeve, K.P 1585
Rajendran, K 2321, 2438
Rajendrudu, G 540, 652, 653, 654
Rajesh Kumar 2749
Rajesh, N 2656, 3401
Rajinder, S 776
Rajkhowa, S 1655, 3476
Rajput, A 1544
Rajput, K.S 615, 698, 733, 734
Rajput, S.S 4243, 4244, 4245, 4246, 4247, 4271, 4282, 4414, 4602, 4603
Raknes, E 4413, 4709
Ram Prasad 119
Ram, B.S 2200, 2201, 3410, 3477
Ram, J 377
Ram, M 2479
Ram, N 328, 329
Ramakrishna, A 3853, 3854
Ramakrishnan, K 2763
Ramakrishnan, T.S 2763
Ramakrishnan, V 4051
Ramamritham, S 4710
Raman, N 509
Raman, S 3042
Ramana Rao, P.V 1545
Ramanwong, K 510
Ramarao, P 475
Ramaswamy, S 4438, 4439, 4745
Rambabu, N 971, 1665, 3523, 3796
Ramesh, K.R 2764, 2765, 2766, 2767
Ramirez, C 1546
Ramnarine, S 045, 3766
Ramola, R.C 4474

Ramos, L 1695, 1696, 1697, 1698
Ramswarup 065
Ramteke, P.K 4143
Rana, B.S 330
Rana, G.S 4248
Rana, P.K 1783
Rana, R.S 4272, 4273, 4420
Ranasinghe, D.M.S.H.K 2439, 2440
Ranatunga, M.S 1920, 4604
Rance, W 1123, 3620
Rand, C 2533
Rane, N 3043
Ranganathan, P.B 3855
Ranganathan, S.K 4353, 4556
Rangarajan, T.N 446
Rangaraju, T.S 4233
Rangaswamy, C.R 2314, 2315
Ranjit Singh, T 2202
Rao, A.L 1657, 3767
Rao, A.L.J 619
Rao, B.K.S 104, 447, 526
Rao, B.R.M 331
Rao, C.J.M 4133
Rao, D.S 2534, 3768
Rao, H.S 795
Rao, K.R 419, 678, 4131, 4132, 4134, 4242
Rao, K.S 615, 698, 699, 733, 734, 4106, 4135, 4136, 4605, 4649
Rao, K.V 448, 449
Rao, K.V.R 442, 443
Rao, P.B 422, 423
Rao, P.S 046, 616, 1004, 1005, 1656
Rao, P.V.K 4411
Rao, R 2768
Rao, R.V 3478
Rao, S.V.V.S 3255
Rao, T.K 3255
Rao, T.L.N 4442, 4443
Rao, V.G 2759
Rao, V.S 700
Rao, V.S.J 1207
Rao, V.V.S.V 314, 538
Rao, Y.S 013, 3769
Rappard, F.W 1208, 3044, 3045
Rasmihiran, W 1124
Ratanakoses, S 1547, 1548, 1775, 3479
Ratanaporncharern, W 1433
Ratheesh, N 2749
Rathod, R 332, 333, 334, 335, 450, 451, 602
Rathor, A.K.S 276
Rathore, N.S 3106
Rativanichi, T 3046, 4287
Raturi, D.P 071
Raunio, A.L 2203
Rauthan, B.S 2275
Raveendran, T.V 4505
Ravichandran, V.K 573
Raviya, R.D 1157
Rawat, A.S 3480
Rawat, B.S 4248, 4274, 4275, 4414
Rawat, H.S 3444
Rawat, J.K 462, 2316, 3770
Rawat, M 4721
Rawat, M.S 783, 796, 925, 927, 1006, 1007, 1017, 1033, 1763, 1776, 1777, 1794, 1795, 4267
Raweesri, S 336
Raynor, E.W 1329
Razak, M.A.A 037
Record, S.J 4052
Reddell, P 625
Reddy, A.G.S 3036
Reddy, B.J.D 508
Reddy, C.J 3481
Reddy, C.V.K 1657
Reddy, G.V.N 4557, 4753
Reddy, M.R 4557, 4753, 4754
Reddy, S.K 1778
Reddy, V.A 4754
Regd, J.D 1354
Reghu, C.P 4133
Regu, K 2878
Rehman, M.A 4249, 4544, 4558, 4559, 4560
Reinsch, H.H 4415
Remadevi, O.K 3047, 3048, 3098, 3219
Renes, G.J.B 3482
Resende, M.D.V de 1008
Reuysungneun, S 337
Ribbontrop, B 2618, 3771
Richens, R.H 797
Richter, H.G 590, 4053
Ridley, N.H 564
Rierink, A 4444
Rietz, G 2619
Rimbawanto, A 1009, 1010, 1041
Ringo, W.N 4112
Rios R, C.A 701
Rittenhouse, R.C 4387
Rittirangsrirot, Ch 1125
Ritz, A 3772
Robertson, B 2204
Robles, X 1205
Rocafort, J.E 4290
Rochmini S dan 141
Roder, W 2441
Rodger, A 2535, 3483, 3773, 3774
Rodger, H 2620
Rodrigo, J.C.P.N.A 1927
Rodrigues, A.L.G 1454
Rodriguez Marcano, A 1928
Rodriguez, A 2384
Rodriguez, D 1929
Rodriguez, R 1695, 1696, 1697, 1698
Roessel, B.W.P 2317
Roettcher, K 2678, 2679
Rogers, C.G 3484
Rojas, O 2205
Roldan, F.E 2769
Roliadi, H 4738
Romanis, R 4354
Romeijn, P 3775
Roonwal, M.L 3049
Roosendael, J van 1209, 1355, 1930, 2206, 2442, 2443, 2444, 2445
Rosamah, E 4382
Rosdi, K 1227
Rosevear, D.R 1126
Rosli, H.M 983
Ross, J.K 1127, 3485
Ross, P 142, 1931, 2207, 4646
Rosso, F 2585
Rosswall, T 307
Roth Meyer, M 4666
Rouysungnern, S 338
Row, L.R 4350
Rowntree, J.B 1779
Roxburgh, W 565
Roy, P.S 3486
Royal College of Forestry, Sweden 1549, 1550
Royal Forest Department, Bangkok 4606
Roychoudhury, K.C 2208
Roychoudhury, N 595, 596, 3050, 3051, 3052, 3053, 3054, 3055, 3056, 3057, 4483, 4484, 4506, 4507, 4508, 4509, 4510
Rudge, E.A 4308
Rudman, P 4355, 4356, 4470, 4471, 4472, 4511, 4512, 4513, 4514, 4515, 4516
Ruengthanom, Q.S 735
Rugmini, P 195, 196, 2976, 2977, 3371, 3375, 3376, 3377, 3487, 4093
Rujakom, S 1551
Rulianti, E 4108
Rundberg, Og G 574
Rungsimanop, C 1854
Rusydi, R 3247
Rutherford 3058
Rutten, L 702
Ryan, A 4250
Ryan, G.M 1780
Ryan, P.A 3776
Sabharwal, L.R 339
Sabhasri, S 541

Sabnis, S.D 1061
Sachan, R.S 340
Sadhardjo 4142
Saengdech, T 1552
Saengsakul, P 4288
Sagreiya, K.P 1011, 1210, 1356, 1357, 1358, 2209, 2210, 2211, 2212, 2213, 2536, 3488, 3489, 3490, 3491
Sah, A.K 2312
Saha, S 143
Sahai, K 1553
Sahibuli, T 3039
Sahri, M.H 2308, 4251
Sahu, S 341
Sahunalu, P 105, 342, 1278, 2472, 3461
Sai, V.S 1160
Saikia, C.N 4723
Saing, T.K 3492
Saini, B.C 1554
Sajeev, T.V 3059, 3116, 3169, 3173, 3182, 3190, 3191
Saju Varghese 3699
Saju, P.U 1658
Sakai, K 4324
Sakai, M 724
Sakcharoen, S 1555
Sakchoowong, W 3183
Saksena, S.B 511, 2770
Sakuno, T 4336, 4378, 4399, 4548
Sakurai, S 1932
Sakurai, T 4187
Salazar, F.R 080
Salazar, R 671, 1407, 1546, 1587, 3413
Saleh, W 4778
Sales, C 4561
Salifu, K.F 106, 343, 344, 345
Salleh Mohd Nor 3777
Sallenave, P 4252, 4253
Salmiah, U 2771, 2772
Salomon, T 2446
Samantakul, V 3493
Samapudhi, K 047, 048, 1182, 3494, 3856, 4562
Sambanandan, K 509
Samra, J.S 353
Samranchit, T 3495
San Buenaventura, P 1933
San Miguel, A 3295
Sandermann, W 3220, 4054, 4055, 4056, 4357, 4358, 4359, 4360, 4361, 4362, 4363, 4364, 4365, 4366, 4367, 4368, 4369
Sandhu, S.S 3040, 3041, 3129, 3184
Sandiford, M 1012
Sandrasegaran, K 2214, 3496, 3497
Sands, W.A 3060
Sanga, J.M 219
Sangal, S.K 4283
Sangat Roemantyo, H 4755
Sangknenw, N 346
Sangkul, S 4647, 4648
Sangwanit, U 510
Sanit Aksornkoae 452
Sankar, S 001, 086, 171, 172, 197, 217, 218, 347, 464, 544, 2459
Sankar, S.J 703
Sankaran, K.V 430, 453, 454, 455, 2697, 3185
Sankaran, V 4556
Santapau, H 1161
Santhadkaran, P 3498
Santhakumaran, L.N 3061, 3062, 4517, 4518, 4519, 4563, 4649
Santhakumarn, L.N 4520
Santhosh, K 3063
Santosa 396
Santosh, K 3064
Sanwo, S.K 4057, 4137, 4254, 4255, 4256
Sanyal, S.N 4202, 4257, 4258, 4259, 4276
Saosaard, A 894
Sara von Arnold 1731
Sarangamath, P.A 577, 578, 579
Saravanan, S 456, 2447
Sardar, M.G 1659, 3778
Sareen, V 617
Sarfo, D 044
Sarin, S.P 4276
Sarkar, A.K 618, 3210, 4490
Sarlin, P 348, 349, 2215, 3779
Sarma, B.K 619
Sarma, C.R 2314, 2315
Sarngadharan, M.G 567
Sarowart, Ch 1556
Sarvottam Rao, C 3065
Sasaki, S 3075
Sasidharan, K.R 823, 980, 1013
Sasikumar, K 994
Sass, U 4130
Sastrodimedjo, R.S 2518, 2544
Sastrodimedjo, S 4416
Sastrodirahardjo, E 3963
Sastry, P.S 1588
Sathe, P.G 3754, 3780
Sathyakumar, K.V 3190
Sato, T 1934
Sattar, A 2801
Sattar, M.A 4260, 4261, 4564, 4565
Sattar, S.A 1005, 1656
Satyamurthi, K.R 1002
Satyanarayana, T 421
Satyendramohan, S 1557
Saunders, R 4184
Savard, J 4058, 4370, 4371, 4521
Savinthoru, S 1558
Saw Eh Dah 3781
Saxena, R.C 4258, 4259
Saxena, R.K 2770
Saxena, V.B 4730, 4731
Saxena, V.S 159, 1269
Schaeffer 1935
Scherr, S.J 2448
Schipper, R.A 3843
Schirie, A 3857
Schlumbom, F 4055
Schmall, S 242, 243
Schmidt, H 3066, 3220
Schmidt, P 3782
Schmincke, K.H 3783
Schmulling 1128
Schneider, T.W 3545
Schnepper, W.O.R 2318
Schokker, P 1359
Scholten, F.K 2216
Schultz, K.H 4372, 4373
Schultz-Dewitz, C 4522
Schulz, K 2531
Schwab, E 4059, 4262
Schwartz, P.B 1936
Scott, C.W 1129, 3067, 3784
Seaman, I.N 4060, 4607
Seaman, L.N 4219
Sebastian, V.O 2857
Sebe, K 4325
See, L.S 2746
Seethalakshmi, K.K 2579, 2580
Seethalakshmi, T.S 824
Seetharamu, L 4417
Sekar, C 3785
Sekar, I 1574
Sekar, T 2217
Sekaran, S 432, 446, 1013
Sekhar, A.C 4061, 4263, 4264, 4265, 4266, 4267, 4268, 4269, 4270, 4271, 4272, 4273, 4274, 4275, 4276, 4277, 4278, 4279, 4280, 4374, 4418, 4419, 4420, 4608, 4650, 4651, 4711
Selaphat, J 4566
Selvi, K.G 145
Sen Gupta, H 2218
Sen Gupta, J.N 963, 1014, 2219
Sen Sarma, P.K 2858, 2995, 3068, 3206, 4523, 4524, 4525
Sen, N.N 2449
Senapati, S.C 3440
Seneviratne, E.W 4567
Senguttuvan, T 2869, 3221
Senthilkumar, N 829

Ser, C.S 4375
Seshadri, T.R 567, 569
Seshagiri, R.K 4431
Seth, S.K 049, 350, 351, 457, 1073, 1130, 1131, 1132, 1360, 1361, 1781, 2220, 3256
Seth, V.K 2221, 3257, 4712
Seth, V.S 3786
Sethuraj, M.R 427
Setiawan, I 1793
Setten, G.G.K 1133
Setty, K.R.V 3254
Seubert, R 1937, 1938
Sevastopulo, D.G 3069
Shaanker, R.U 1086
Shadangi, D.K 148, 1577
Shah, G.L 1150, 1162, 1163, 4122
Shah, J.J 704
Shah, R 4376
Shah, S.A 1134
Shankar, U 2450
Shanmuganathan, K 352, 4779
Shanmugavelu, K.G 1782
Shanmughavel, P 458
Shanthi, A 793
Sharma, A.K 4201
Sharma, B.D 4257
Sharma, C.M 3486
Sharma, D.C 286, 462, 3442
Sharma, D.R 230, 402, 403
Sharma, J.K 1559, 1560, 2698, 2750, 2773, 2774, 2775
Sharma, K 473, 4720, 4721
Sharma, K.C 798
Sharma, M 4377
Sharma, M.C 1660, 1690
Sharma, R 761, 793, 800, 801, 891, 959, 972, 1015, 1016, 3601
Sharma, R.B 340
Sharma, R.C 2296
Sharma, R.R 4243, 4244, 4278
Sharma, R.S 4277, 4608
Sharma, S 889, 1576, 1676, 1783, 4483
Sharma, S.C 313, 437, 438, 439, 440, 459, 1156
Sharma, S.D 353
Sharma, S.K 353, 1939, 4756
Sharma, S.L 1007, 1017
Sharma, V 2776, 2985
Sharma, V.K 885, 1784
Sharma, V.P 744
Sharon, M 1734
Shashikala, S 3478
Shebbeare, E.O 3787
Sheeba, K.K 498
Shekhargouda, M 578
Shende, N.V 3499
Shende, T.K 3499
Shetye, P.K 512
Shibusawa, T 4445
Shida, S 4445
Shigematsu, Y 4281
Shinde, P.S 2346
Shinde, S.R 2451
Shinohara, T 4378
Shintorn, S 1561
Shiraishi, S 1041
Shirin, F 618
Shirley, G.S 1562, 2222, 2223, 3500, 3501
Shivaraju, B 3768
Shobhana, K 2336
Shrihari, P.V 1778
Shrivastava, B.K 431
Shrivastava, R.K 846
Shukla, K.S 4421, 4422
Shukla, N.K 4243, 4244, 4245, 4246, 4247, 4279, 4282, 4283, 4423
Shukla, P.K 1478, 3885, 4485
Shukla, S.K 1211
Shuzhen, Z 1684
Shyam Sundar, S 3788
Shyamasundar, K 4424
Siaw, D.E.K.A 1629
Sibomana, G 2224
Sickder, A.B 722
Siddappa 1013
Siddappa Kannur 1661, 2319
Siddaramaiah, A.L 2740
Sidhu, D.S 2369
Siegismund, H.R 781, 950
Sierra-Alvarez, R 2744, 4049
Sieverts, A 1940
Sihler, K 2686
Silva J.M da 1454
Silva, M.D de 3070
Silva, R 3551
Silverborg, S.B 4530
Sim, B.L 913
Sim, H.C 4284
Simatupang, M.H 628, 629, 630, 1941, 4056, 4322, 4360, 4362, 4363, 4364, 4365, 4366, 4367, 4368, 4369, 4379, 4380, 4381, 4382, 4383
Simmons, C.E 1212
Simon, H 3789, 3858, 3859
Singh, A.K 354, 355, 389, 460, 3284, 3502, 3503, 3504, 4485
Singh, A.N 356
Singh, B 354, 1563, 2225, 2984, 3071
Singh, B.G 1013, 1515, 1566
Singh, B.P 232, 330, 2534
Singh, C.S 493
Singh, D 357
Singh, E.N 358
Singh, G 2363, 2452
Singh, G.J.R 655
Singh, I.J 3486
Singh, J 359, 360, 1164, 1269, 1362, 1942, 4338, 4339, 4704, 4740
Singh, J.A 3790
Singh, J.S 356, 1018
Singh, K 240, 353, 363, 367, 548, 2529, 4409, 4705
Singh, K.P 361, 362, 644, 656, 659, 705, 3385
Singh, K.R 4158, 4159, 4257, 4280, 4423
Singh, M 461
Singh, M.M 3505, 4730, 4731, 4732, 4733
Singh, N.B 1019
Singh, N.P 409
Singh, N.T 231, 2363
Singh, O 462
Singh, P 364, 598, 1135, 2226, 2951, 3072, 3073, 3222, 3223, 4384, 4446
Singh, P.K 706
Singh, R 367, 2479, 3073
Singh, R.B 365, 366
Singh, R.K 367
Singh, R.P 422, 423, 1458
Singh, R.R 1733
Singh, R.V 798, 1554
Singh, S 1675, 2696, 2777, 2778, 3074, 4458
Singh, S.B 220, 241, 322, 368, 369, 370, 371, 3506, 3681
Singh, S.K 619
Singh, S.M 4425
Singh, S.P 649, 1785, 2083, 3095, 3507
Singh, S.S 358
Singh, T 1564
Singh, T.C.N 4376
Singh, T.P 372
Singh, U 1764, 1765, 2320, 2694, 2696
Singh, U.P 619
Singh, V 1145
Singh, V.K 2081
Singh, V.P 407, 408, 409, 410, 575, 1165
Singhal, P.C 3508
Singhal, R.M 353, 1662, 1725, 2537
Sinha, A 463, 1020
Sinha, A.K 620
Sinha, B.R.R.P 2967
Sinha, J.N 3683

Sinha, R.R 427
Sinha, U.S.P 620
Siriaupotham, Ch 4346
Sirikul, W 1565
Siril, E.A 1786, 1792
Siringoringo, H.H 081
Siripatanadilok, S 657, 658, 2308
Sirito, N.B 2227
Siriwallop, K 1663
Sisukho, M 2228
Siswamartana, S 050, 3509
Siswantoyo 2453
Sita, G.L 1787
Sitaraman, N.L 4353
Sithidisairak, P 3258
Sivagnanam, K 622
Sivaji, V 706
Sivakumar, V 1566
Sivananda, V 4713
Sivarajan, M 2538
Sivaramakrishnan, V.R 3048, 3186
Sklar, P.I 4727
Skoupy, J 1956
Skovsgaard, J.P 3549
Slade, H 2621, 4062
Slinkers, T.L 2454
Smeathers, R 4285
Smith, R 2455
Smitinand, T 1166, 3038, 3039
Smythies, E.A 1943
Snepvangers, F.W 2229, 2230, 3791
Snepvangers, P.W 2231
Sobukawa, T 4426
Soda, R 3075
Sody, H.J.V 160
Soebroto, P.M 1044
Soedihardjo, E 3933
Soekartiko, B 2456
Soekeri 2457
Soemaatmadja, S.A.S 3510, 3860, 3861
Soemarna, K 3511, 3512
Soemarso 3792
Soemarwanto, O 2458
Soenarno 2515, 2516, 2539
Soenarso, S 2540, 2541
Soenarya, Y 1945
Soerianegara, I 799, 901, 1021, 1944
Soerjohadikoesoemo, D 4652
Soerjono, R 539
Soernnggabjiwa, M.H 2542
Soerohaldoko, S 396
Soeroso, R 4781
Soesilotomo, P.S 1945, 2666
Soest, G.H van 1136
Soeters, K 707, 2232, 2543
Soetrisno, H 3259
Soewito 2544, 2553
Sohi, H.S 587
Solanki, K.R 2479
Somabutra, B 1664
Somaiya, R.T 3934
Soman, C.K 532, 2655, 2656
Soman, P 270, 2964
Somarriba, E 1946
Somashekar, P.V 2268
Somasiri, S 523
Somasundaram, T.R 1631
Sombun, K 1732
Somsophon, U 373
Songkul, S 3493
Soni, K.K 480, 2779, 2780, 2781
Soni, P 374
Soni, P.L 4757
Sonntag, U 4053
Sono, P 1363, 1567, 3513, 3514, 3515, 3516, 4286, 4287, 4288
Sood, K.G 2528
Sood, L.K 3885
Sood, V.K 4758
Soonyakhanit, S 3517
Soosairaj, S 1068
Southwell, C.R 4526
Souvannavong, O 3840
Sowani, M.Y 1269, 3518
Spaan, W.J 1364
Sparkes, A.J 4289
Speight, M.R 3076
Spoon, W 4759
Sprinz, P.T 3519
Sreefuree, T.S 4063
Sreekumar, V 3704
Sreenivasa, M.N 486, 487
Sri Esti Intari 3077
Srijono, D.W 1213
Sriklam, I 4609
Srimathi, P 622
Srimathi, R.A 708, 1568, 2582
Srinivasa, Y.B 3047, 3288, 3398
Srinivasan, G 2928
Srinivasan, T.K 3078
Srinivasan, V.M 300, 1649, 1789, 3434, 3435
Srinivasan, V.V 4349, 4649
Srinukool, S 1854
Srisakdi, P 4138
Srisook, P 2545
Srisuko, M 3793
Srisuksai, B 375
Srivas, N.C 357
Srivastava, A 3438
Srivastava, A.K 1947
Srivastava, H.P 2782
Srivastava, M.M 376
Srivastava, P 1948
Srivastava, P.B.L 286
Srivastava, R 377
Srivastava, R.J 625
Srivastava, S.K 362, 656, 659, 705
Srivastava, S.S 1365, 2233
Srivastava, V.K 144, 3254, 3260, 3454, 3520
Srivasuki, K.P 519, 520, 1588
Staines, H 3147, 3148
Starte, H.W 3079, 4139
State Agricultural University, Wageningen 1949
State Timber Board, Burma 4610
Stebbing, E.P 1137, 1138, 2234, 3080, 3081, 3082, 3083, 3084, 3085, 3086, 3087, 3088, 3089, 3794
Steber, B 3795
Steenis, C.C.G van 3261
Stefanov, B 4427
Steinbeck, K 4447
Sterringa, J.T 2665
Stokes, A 4120
Stone, E.L 085
Stoutjesdijk, J.A.J.H 1366, 3521, 3522
Stoyanov, D 4348
Street, E.C.F 4064
Streets, R.J 1139
Strugnell, E.J 3862
Sturre, T 3962
Suangtho, P 894
Suangtho, V 781, 818, 852, 853, 946, 1022, 1569, 1570
Suarez, M 3581
Suavin, L 411, 412
Subrahmanyam, M.V.R 2276, 2378
Subrahmanyam, S.V.S 442, 443
Subramaniam, B.A 1950
Subramanian, K 824, 981, 982, 1637, 1638, 1659, 1665, 1771, 2263, 3378, 3523, 3796, 4143
Subramanian, K.N 1023, 1024, 1631
Subramanian, V 2321, 2352
Sudarmo, M.K 2235, 3524, 3797
Sudha, P 2636
Sudhakara, K 394, 597, 917, 918, 1479, 3113, 3525
Sudheendrakumar, V.V 2978, 3013, 3015, 3016, 3017, 3018, 3019, 3020, 3090, 3091, 3092, 3093, 3094, 3095, 3096, 3115, 3116, 3131, 3132, 3169, 3170, 3171, 3172, 3173, 3181, 3182, 3187, 3188, 3189, 3190, 3191, 3192, 3193, 3194, 3526, 4493, 4494

Sudiono, J 3798
Sudiono, Y 3512
Sudjud, D.A 2669
Sugavanam, V 513
Suh, J.S 4714
Suhaimi, W.C 302, 571
Suhartana, S 2517, 2546
Suharti, M 2667, 2668, 2669, 3097
Suhendi 766
Sujatha, M.P 464, 544, 621, 2459
Sukaesih Parajadinata 1113
Suksawasdi, S 3799
Sukumar, R 2105, 3003
Sukwathana, P 2547
Sukwong, S 383, 1214, 1571, 3382, 3527, 3528, 3529, 4140
Sullivan, G.M 2460
Sumamburat, W 1680
Sumantakul, V 1025, 1026, 1027, 1367, 1572, 1603, 1666, 1788, 2480
Sumantri, I 2548, 4416
Sumathi, R 1800, 1801
Sunanda, C 394, 3704
Sundarapandian, S 118, 3530, 3531
Sundararaj, R 2878, 3098
Sunderlin, W 2460
Sundralingam, P 2322
Sung, S.M 3121
Sunitibala, Y 660
Supidhyaporn, W 1573
Supriana, N 3099, 4527, 4528
Surachet Ungkulpadikul 061
Suranggadjiwa, M.H 3262
Suraphapmaitri, S 105, 2236
Suratmo, F.G 3100, 3101
Surekha, K 3194
Surendran, C 994, 2199, 3785
Surendran, T 664, 686, 1589
Suresh, H.S 2105
Suresh, K.K 1574
Suri, S 240
Suri, S.K 709, 1028, 3532, 3533, 3534, 3935, 3936
Surjokusumo, S 2488
Surya Rao, P 419
Suryanarayana, V 501
Suryasanoesiputra, H 3963
Susaeta, E 3780, 3800
Sushil Kumar 2953, 3102
Sutapak, S 378
Sutarja, D.S 661
Sutat Sriwatanaponge 1000
Sutherland, S 1916, 2461
Sutigno, P 4653
Sutjiati, L 1680
Sutomo, S 131
Sutopo, S 4141
Suttie, W.R 1368
Suvarnasudhi, K 4065, 4066
Suwannapinunt, W 379, 382, 383, 468, 2323
Suwannaratana, S 465
Suwanwaree, P 2586
Suzuki, I 4671
Swain, D 148, 800, 801, 1016
Swain, S.L 433, 1369
Swaminath, M.H 763, 1951
Swaminathan, C 622, 1789, 3785
Swamy, B.V.R 1787
Swamy, H.R 466
Swamy, P.S 118, 3530, 3531
Swaran, P.R 3103
Swaroop, C 4410
Swe, M 3535
Sweet, J.M 1370, 2462
Sylianco, C.Y.L 623
Sylviani 4448
Szen, I.S.T 3104
Szmidt, A.E 869
Taggarse, P.M 1952
Tajuddin, E 014
Takahashi, A 4187
Takamura, N 4693
Takenami, K 4428
Takle, G.G 1371, 1372
Talukdar, N.C 514
Talukdar, Y.A 4565
Tamboli, R.A 467
Tamolang, F.B 4290
Tamolang, F.N 3930, 4322
Tampubolon, A.P 542
Tan, S.M 398, 470
Tan, Y.E 4715
Tanaka, N 107
Tandon, M.N 2237
Tandon, R.D 4132, 4134, 4242
Tandon, S 1553
Tandon, V.N 286, 3444
Tang, H.T 380
Tangmitcharoen, S 825, 826, 827, 828
Tangtham, N 061, 495, 543, 3536
Tanskley, S.D 1029
Tantangkul, Ch 3537
Tantiraphan, W 223
Tanukit, W 1667
Tarasingh 1373
Tariel, J 1953
Tarumingkeng, R.C 3023
Taschan, Ch 3538
Tateishi, R 3541
Tativa, G.E 4142
Tattiemromya, P 2549
Tawee Kaewla iad 452, 3529, 3539
Tay, S.P 3777
Teak Improvement Centre, Ngao 1030, 2238
Teak Sub-Commission, Indonesia 1140, 1141
TEAKNET 1142, 1668, 4780
Teckchandani, C.K 4750
Tedjokoesoemo, R.H 4598
Tee, B 2463
Tego Agbo Kangni, M 3540
Temu, A.B 3417, 4067
Teo, C.K.H 1709
Tetuko, S.S.J 3541
Tewari, A 052
Tewari, D.N 015, 802, 1143, 1790, 3740, 3800, 3937
Tewari, M.C 4352, 4529
Tewari, R.K 2778
Teyadhiti, M 2464
Tha Tun San 3251
Thaiutsa, B 284, 379, 381, 382, 383, 468, 1374, 2239, 2323, 3528, 3542
Thakare, A.R 2263
Thakur, B.S 4746
Thakur, M.I 3102
Thakur, M.L 3068, 3105, 3199, 3200, 4525
Thakur, R.K 3106
Thakuria, D 514
Thammanon, P 108
Thammincha, S 3265
Thampi, K.B 1375
Thanchai, P 1669
Thangam, E.S 3801
Thangaraja, A 829
Thaninpong, S 1575
Thapa, R 515, 516
Thapliyal, M 145
Thephasdin, M 2550
Thiamthong, S 1538
Thirawatana, S 3938
Thirumalachar, M.J 2783
Thit, A.T 662
Thite, A.N 2734, 2784, 2785
Thittaw-Wunmin 1376
Thomas, A.V 4291
Thomas, R 1144
Thomas, T.P 170, 171, 172, 197, 384, 544
Thompson 3543
Thompson, G.W 1791
Thompson, R.C 3107
Thomsen, A 895
Thomson, B.R 2157, 2240
Thongma, Ch 3544
Thontadarya, T.S 3025, 3026, 3027, 3028, 3029, 3174, 3175, 3176, 3177

Thorenaar, A 146, 385, 386, 803, 1377
Thornton, J.D 2875
Thulasidas, P.K 4094
Thyagarajan, M 1954
Ticku, B.L 1269
Tiffani, F 3939
Tilakaratna, D 3108, 3195
Timber Development Association, London 4068
Timber Industry Development Division, Ghana Forestry Commission 3940
Timmer, P 2622
Tinambunan, D 109
Tint, K 3545, 3802
Tint, S 4069
Tireman, H 3546
Tiwari, C.K 1576, 2723, 2724
Tiwari, D.P 2786, 4760
Tiwari, K.P 504, 1268, 1544, 1792, 3263
Tiwari, S.C 358
Tiwari, S.D.N 082, 2241, 3109, 3110
Tiwari, S.K 1786, 1792, 2262
Tiyanon, S 2239
Tjarmat, E 2518
Tjau, I.K 1955
Tjitrosoedirdjo, S 2670
Tobi, E 2465
Tobing, T.L 2308
Tochigi, T 4675
Toda, R 799, 804
Toma, T 646
Tomar, M.S 3257
Tomazello, M 736
Topp, T 4070
Torres, A 294, 592
Torres, F 3547
Torres, L 4530
Torres, S 2324
Totey, N.G 147, 148, 211, 320, 355, 387, 388, 389, 393, 1577, 1670
Tottenham, W.F.L 3941
Trevor, C.G 1215, 2242, 3803
Triguero-Issasi, N 2965
Trina, D 1695
Tripathi, A 624
Tripathi, A.K 581
Tripathi, S 624
Tripathi, S.P 2452
Triratana, S 4761
Trivedi Babu, N.V 1216
Trivedi, B.K 3508
Triwilaida 203
Trockenbrodt, M 4611
Trotter, H 4071, 4654
Troup, R.S 1217, 1578, 1579, 2551, 2623, 2624, 3111, 3264, 4072, 4655, 4656
Tu, S.H 3914
Tuggerse, M.S 1580, 1581, 1582, 1583, 1584
Tun, T 1671
Turnbull, J.W 1048, 1488
Tuteja, S.C 1145
Tze, W.T.Y 4612
U Kyaw Zan 2243
U Saw Tun Aung 1378, 1379
Udaiyan, K 513
Ugalde Arias, L.A 100, 1146, 1218, 1219, 1220, 1221, 1222, 2079, 2190, 2313, 3325, 3550
Ugalde, L 1922
Ujjaini, M.M 477
Ullah, M.H 1269
Ullevalseter, R.O 4568
Umaly, R.C 2670
Umboh, I 1793
Unahanand, P 1260
United Nations Economic and Social Commission for Asia and the
Pacific, Bangkok 016
University of West Indies, Trinidad 2671, 2672
Uniyal, B.M 4735
Uniyal, D.P 1006, 1007, 1033, 1784, 1794
Unnikrishnan, K 704, 1585
Unnithan, V.K.G 1479
Unwin, R 3548, 3804
Upadhyay, R.S 659
Upadhyaya, A.K 2805
Upadhyaya, S.D 1165
Upreti, N.K 4349
Vacharangkura, T 107
Vaclav, E 1031, 1032, 1956
Vagyani, B.A 467
Vahid, S.A 390, 2244
Vaidyeswaran, R 4431
Vaishampayan, S.M 2843, 2844, 3112, 3224
Vakshasya, R.K 710, 1033, 1795
Valera, L 1034
Vallauri, D 1755
Vallejo, A.P 1223
Vallil, G 4657
Vanangamudi, K 1504
Vanclay, J.K 3549
Vanitha, S 2787
Vany, J.J.H 3104
Varangis, P 3942
Varghese, G 129, 417, 1164
Varghese, M 823, 980, 982, 1035, 4143
Varghese, V 585, 586
Varma, B.A 3113
Varma, R.V 2869, 3015, 3018, 3019, 3020, 3091, 3092, 3103, 3114, 3115, 3116, 3132, 3169, 3171, 3172, 3173, 3181, 3182, 3190, 3191, 3221, 3605, 4493, 4494
Varmah, J.C 3863
Varmola, M.I 3805
Vasava, S.S 3763
Vasquez, C.W 3550
Vasquez, W 1586, 1587, 2079
Vastrad, A.S 3117
Vasudeva, R 763, 815, 830, 896, 897, 900, 1036, 1516
Veenakumari, K 3118
Veenin, T 2308
Veillon, J.P 3551
Venegas Tovar, L 951
Venekanand 391
Venet, J 4292
Venkaiah, K 1004, 1005, 1656
Venkata Rao, K.R 1329
Venkataraman, K.G 1037
Venkataramana Iyer, K.R 3806
Venkataramany, P 1380, 1381, 1382, 2245, 2466
Venkatasubramanian, N 793, 1013
Venkatesh, C.S 804, 1038, 1726, 2467
Venkateswara Rao, D 4385
Venkateswaran, S 711
Venturin, N 2406
Venugopal, B 712
Venugopal, N 713, 4144, 4145, 4146
Verbeek, F.A.T.H 3119
Verhaegen, D 1184
Verhoef, L 392
Verinumbe, I 2468, 2469
Verma, G.M 4232, 4340, 4341, 4342, 4343, 4496, 4498
Verma, R 3112
Verma, R.K 083, 148, 393, 517, 518, 1576
Vermeer, D.J.M 4386
Vernay, M 4293
Versluis, W 714
Vicente, S.M 3623
Victor, V.J 4155, 4405, 4417, 4424
Vidal, J 1147
Vidal, M.P.H 1224
Videlov, K.H 4568
Vidyasagar 4555
Vidyasagar, K 3401
Vidyasagaran, K 585
Vigneron, P 913

Vijaya, T 519, 520, 1588
Vijayachandran, S.N 1409, 2798
Vijayakumar, N.K 966
Vijayalakshmi, G 2268
Villar, A.R 3120
Vimal, M 394
Vimuktalob, C 2464
Vincent, A.J 3552
Vincent, L 3422, 3553, 3580
Viquez, E 2185, 2190
Visetsiri, K 1612
Viswanath, S 1589
Vivekanandan, K 1039, 1040, 3225
Voogd, C.N.A de 2470
Vora, A.B 149
Vreeling, L 4658
Vyas, K.M 2770
Vyas, L.N 469
Wacharakitti, S 289
Wacharinrat, C 1374
Wachirajutiphong, T 395
Wadeturer, R.N 876
Wadhwani, A.M 776
Wagenfuhr, R 4073
Wagh, A.B 4505
Wahab, M.A 1964
Wahap, L.A 1755
Wahid, P.A 597, 703, 3525
Wahyudi, I 3554, 4047
Waidarp, P 3555
Walker, H.C 1383, 1384, 2471, 2625, 3807
Walker, R 3829
Wanakich, L.P 2552
Wang, B.G 2325
Wang, B.S 1689, 1796
Wang, D.C 111
Wang, F.Z 485
Wang, P.Y 3121
Wang, S.Y 4147, 4220, 4294, 4295, 4429, 4716, 4717
Wang, T.H 3122
Wang, Y 580
Wang, Y.G 1047
Wangaard, F.F 4160
Wangcharoen, K 715
Wangtara Buitan 3556
Wangtara, N 1716
Wanichkul, M 2246
Wanner, H 396
Wardono Saleh 3864
Warren, W.D.M 1797
Warta, A.J 3557, 3558, 3943, 3944, 4613
Wartono Kadri 2553
Wasuvanich, P 1590
Watanabe, A 1041
Watanabe, H 2472, 3554
Wataniyakul, T 1591
Watcharakitti, S 1592, 3265
Waterman, P.G 568
Waterston, J.M 2761
Watling, R 2772
Watson, G.A 2473
Watson, H.W.A 3865
Watt, G 4762
Wattankul, S 4296
Watterston, K.G 397
Watts, H.C 2247
Weaver, P.L 1148, 3559, 4074
Webb, D 931
Webb, M.J 625
Wechel, A Te 1824, 2248
Wechel, G.L Te 3922
Weeraratna, W.G 3560
Weerawaradne, N.D.R 3561
Wegelius, C 1487
Wegener, G 626
Wehlburg, A.F 3562, 4614
Weidema, W.J 2249
Weissmann, G 3046, 4361
Wellendorf, H 933, 935, 948, 1042
Wenming, L 1599
Wepf, W 1957, 2250, 2474
Wesley, D.G 2475
Westra, J.G 1385, 2554, 3945
White, K.J 017, 018, 019, 805, 1149, 1386, 1798, 2251
White, R.K 4101
White, T 1043
Whitehead, D 716
Wickneswari, R 1964
Widiarti, A 4448
Widodo, A.C 4416
Widyatmoko, A 1041
Wiersum, K.F 3782
Wijesinghe, L.C.A 1593, 1594
Wijesinghe, M.T.J.P 4447
Wikantika, K 3541
Wilhemi, T 3563
Wille, W.E 4174
Willeitner, H 4456
Willemsen, J.W 2476
William Logan 3808
Williams, G.H.D 1224
Williams, R.S 4297
Wilson, C.C 2252, 2253
Wilson, P.H 1958, 1959
Wimbush, A 1387, 1595, 2254, 3564
Win Maung, U 4298
Win, S 2477, 3565
Win, U.N 1388
Wind, R 1596, 3809
Windeisen, E 626
Winit-Rakchat 1799
Winkle, R van 3810
Winter, K 627
Winters, R.K 3866
Wirapradja, A 2544
Wirjodarmodjo 1767
Wirjodarmodjo, H 1044, 4781
Wiroatmodjo, R.S 1960, 2255, 3566, 3567, 3811
Wise, L.E 4387
Wisnu, J 4108
Wiwatwitaya, D 3196
Woessner, R.A 3291
Wolcott, G.N 3226, 3227, 3228, 4531
Wolff von Wulfing, H.E 2587, 3568, 3569, 3570, 3571, 3572, 3573, 3574, 3575, 3576, 4075
Womersley, J.S 3104
Wong, C.N 4718
Wong, S.M 1601
Wong, W.C 4718
Wongsakulwiwatana, S 2478
Wood, P.J 806, 1597, 1598, 2256, 2257
Wood, T 4397
Woods, R.P 4299, 4659
Woodvine, F 2272
Woraraksa, B 110
World Bank, Washington 3812
Wroughton, F.H 2555
Wu, H.T 4569
Wu, S.H 3122
Wu, S.X 2864
Wu, W.J 2855
Wu, W.N 3123
Wu, W.Y 3914
Wutisatrian, A 3577
Wyatt Smith, J 807, 1045, 1961, 2258, 3813
Wycherley, P.R 1225, 1962
Xie, X.R 1047
Xie, X.Y 4473
Xu, H.C 2482
Xue, L 398, 470
Xuezhi, S 1599
Yacoob, M.H.S 3157
Yadav, A.K 545, 546, 547
Yadav, A.S 1672, 3124, 3578
Yadav, J.P 1600
Yadav, J.S.P 049, 230, 326, 351, 399, 400, 401, 402, 403, 457, 548
Yadav, R.R 718, 737
Yadav, R.S 2479
Yadav, S.S 1150, 1163
Yagishita, M 4719
Yakub, M 4300
Yamada, H 1963
Yamamoto, H 3554, 4047
Yamamoto, K 628, 629, 630, 4383

Yamamoto, R.T 4479
Yang, K.C 1431
Yang, Y.C 111
Yani, S 1793
Yap, S.K 646, 1601
Yarwudhi, C 1374
Yasodha, R 1800, 1801
Yatagai, M 4388
Yawuthi, Ch 3579
Ybarra Coronado, R 2041
Yeole, P.R 3125
Yin, G.T 2482
Yincharoen, S 3021, 3146, 3203
Yingchoi, P 396
Yingransiri, T 1026, 1027, 1046, 1367, 1572, 1602, 1603, 1716, 1788, 2480, 3392
Yokota, T 4326
Yonenobu, H 4389
Yoneta, M 4570
Yoshida, M 3554
Yoshimura, M 2788, 4532, 4533, 4534
Young, G.D 4019
Younus-uzzaman, M 4547
Yousof, Y 1755
Zachariah, P.K 2481
Zacharias, V.J 3197
Zade, U.B 2346
Zainudin, H.M.A 1868
Zakaria, B 2524
Zakaria, I 051, 1227
Zaman, M.N 2135
Zambrano, T 3580, 3581
Zech, W 088, 242, 243, 404, 582, 631, 632, 2295, 3582
Zeeuw, C.H de 4301
Zeide, B 3705
Zeng, B.S 2482
Zethner, O 3126, 3127, 3128
Zeya, A 831
Zhang, R.G 1047
Zhen, S.Z 955
Zheng, S 956
Zhou, Z.Z 040
Zizp, W.A 1151
Zobel, B.J 1048
Zon, P van 1226
Zondag, J.L.P 3583
Zoolagud, S.S 4233
Zope, J.S 1802
Zuhaidi, A.Y 1227, 1964, 3723
Zwart, W 1152, 1965, 2259, 2556, 2588, 3266, 3584

Subject Index

Abnormalities, 694, 4104
  leaves, 714, 750
  seedlings, 710
  Acanthophorus
  seed orchards, 2909

Accelerated ageing
  seed germination, 1509

Acervus epispartius
  Sarcoscyphaceous fungi, 2762

Acetic acid
  seed germination, 1499

Achatina fulica, 3045

Acherontia lachesis, 3034

Achievements
  Madagascar, 3857

Acid deposition
  leaves, 74

Acid phosphatase
  vam fungi, 475

Acid resistance
  mineral acids, 4521

Acid tolerance
  clones, 992

Acid treatment
  acetic acid, 1499
  hydrochloric acid, 1481, 1497
  seed germination, 1418, 1429, 1432, 1481, 1497, 1499, 1504, 1552, 1561, 1592
  seedling vigour, 1504
  sulphuric acid, 1552, 1561, 1592

Acoustic technique
  wood decay, 2744

Acropyga acutiventris
  Crematogaster traubi var. *vastatrix*, 2804

Adaptability
  erosion control, 522

Adhesion techniques
  panel, 4714

Adhesion tension, 4405

Adhesive property, 4404

Adhesives
  polyvinyl acetate, 4417

Adventitious rhizogenesis
  ascorbic acid, 1675
  tissue culture, 1783

Adventitious roots
  IBA, 1676
  thiamine, 1676

Aeolesthes
  beehole borer, 2912

Aerial assessment
  Maharashtra, 3248

Aerial photographs
  Andhra Pradesh, 3263

Aerial spraying
  Hyblaea puera, 3222

Aerial surveys
  inventory, 3239

Afforestation
  Africa, 1850
  America, 1838
  Asia Pacific, 3822
  Australia, 1912
  Bangladesh, 1827
  Bombay, 1829
  Calamus simplicifolius, 2482
  Chambal ravines, 1867
  comap model, 76
  Coral soils, 1860
  cost benefit analysis, 3681
  Costa rica, 1869, 2190
  Cote d'ivoire, 1850
  cultivation, 1830, 1831, 1832, 1833, 1955
  degraded soil, 1949
  dry monsoon areas, 1849
  economics, 1998
  erosion, 1867
  fertilizers, 2277
  forest pedology, 348
  France, 1828, 1831
  greenhouse gas, 76
  Guadalcanal grasslands, 1839
  Gujarat, 3681
  Honduras, 1838
  India, 1951
  Indonesia, 1849, 1871, 1903, 1904, 1949
  Ivory coast, 535, 1902
  Java, 1944
  management, 3822
  mine restoration, 1912
  mixed planting, 2482
  Nicaragua, 2190
  Nigeria, 1858, 2011
  nursery techniques, 1619
  Panama, 1998
  Philippines, 1845
  plantation establishment, 1853, 1869, 1871, 1959
  ploughing, 1955
  regreening programme, 1944
  savanna, 535, 1902
  sewage, 2277
  soil conservation, 535
  soil erosion, 1949
  Solomon Islands, 1839, 1959
  sowing, 1820
  species trials, 1899
  stump planting, 1820
  Tanzania, 1899
  Thailand, 1815
  Togo, 1840
  Togoland, 1272
  transplanting, 1820
  Venezuela, 1862
  Vietnam, 76, 1819
  Windward islands, 1861

Afforestation model
  biodiversity, 1942
  Maharashtra, 1942

Afforestation techniques, 1865

Africa, 127, 349, 636, 1100, 1745, 1746
  afforestation, 1850
  Armillaria mellea, 2726
  cultivation, 1901
  fungus diseases, 2726
  growth, 719
  management, 1999, 3621
  marketing, 44
  plantation grown teak, 1184
  plantation techniques, 2063
  plantations, 242, 1333, 1999, 3230, 3741
  provenance trials, 933
  reforestation, 1850
  silviculture, 1076, 1182, 1184, 1203, 2063, 3741
  socio economics, 3630
  soil fertility, 1333
  soil properties, 242, 349
  species introduction, 1076

utilisation, 44
wood properties, 4040
yield, 1333, 3741
African grown teak
strength properties, 4253
Agaristidae
food plants, 3069
Age, 123, 283, 2089
annual rings, 3471, 4139, 4140
basal area, 3479
carbon storage, 4332
chemical properties, 4389
crown diameter, 3471
density variation, 4209
density, 3705, 4209
diameter, 670, 3510
durability, 4454
fruit size, 1449
gibberellic acid, 1663
growth periodicity, 728
growth, 3282
heartwood proportion, 4112
height, 103, 670, 3475
leaf weight, 715
nursery period, 1649
plant density, 290
plantation grown teak, 4112, 4209
plantations, 103
productivity, 3705
root formation, 650
rotation, 86, 3705
seed germination, 1393, 1449, 1489, 1492
seed size, 1393
seedling growth, 1663
seedling survival, 1492
seedling vigour, 1492
stumps, 1649
teak forests, 1813, 2229, 2532
timber quality, 728
wood structure, 728
Age effect
crown widths, 3460
roots, 3460
timber hardness, 4221, 4224
Ageing
seed germination, 1513, 1514
seedling vigour, 1513, 1514
Agri silviculture
Bagelen, 1377
intercropping, 2438
regeneration, 1377
Tamil Nadu, 2438
Agricultural crops
mixed cropping, 2329
Agriculture policy
Congo, 529
soil conservation, 529
Agroforestry
architectural analysis, 2357
architecture, 2356
Bantam, 1065
biodiversity, 2375
caribbean, 2448
cash crops, 2413, 2436
community forestry, 2439
Costa Rica, 2388
cultivation, 2369, 2427, 2458
degraded forests, 1906
economics, 2369, 2448
fencing, 2461
forest village programme, 2387
growth, 2356, 2357
home gardens, 2356
Indonesia, 2433, 2436, 2456, 2458
intercropping, 2363, 2413, 2440, 2458, 2468
Karnataka, 2419, 2420
Kerala, 2356, 2357, 2426
Maharashtra, 2346
maize, 2468
mixed cropping, 2346, 2419, 2420
Myanmar, 2341, 2351, 2477
Nigeria, 2430, 2468
oil seeds, 2413
Panama, 2388, 2461
productivity, 2352
Punjab, 2369
reforestation, 2453
rehabilitation, 1906
rhizosphere, 487
salt tolerance, 2363
smallholder participation, 2430
social forestry, 1906
socio economics, 2433
Sri Lanka, 2439, 2440
Tamil Nadu, 2352
taungya plantations, 2337
taungya, 2351, 2374, 2413, 2433, 2453, 2456, 2458, 2477
Thailand, 2374, 2375, 2387
undercrops, 2426, 2436
vam fungi, 487
vanalakshmi, 2426
yield, 2363
Agroforestry practices
intensive management, 2435
mixed planting, 2435
Agroforestry systems
economics, 2416, 2423
groundnut, 2418
Karnataka, 2416, 2417, 2418, 2421
mixed cropping, 2417, 2418, 2421
Sorghum bicolor, 2421
Agrosilvicultural systems
economic analysis, 3785
economics, 2464
farm forestry, 2441
intercropping, 2464
Laos, 2441
Tamil Nadu, 3785
Thailand, 2464
Agrosilvopastoral systems
Karnataka, 2422
productivity, 2422
Air craft
gliders, 4215
plywood, 4677
Air drying, 4538
Air layering, 1724
Air seasoning, 4543
Albino rats
enzymes, 605
seed protein, 605
Alcides ludificator, 2834
Alcterogystia cadambae, 3094
clonal seed orchard, 3063
insecticides, 3208
Kerala, 2976
Aleurodicus dispersus
clonal variation, 3047
Alignment chart
thinning, 3234
Allelopathic effects
Allelopathy, 617, 622
Costus speciosus, 601
extracts, 579
Hyptis suaviolens, 1577
leaf extract, 607
leaf leachates, 602

leaves, 577
plant extracts, 1577
seed germination, 573, 577, 578, 579, 602, 611, 624, 1577
seedling growth, 607

Allergy, 574, 4373
deoxylapachol, 4381
eczema, 603, 4386
extractives, 4381
quinones, 4322
tree dust, 603

Allozyme diversity
genetic variation, 950

Alluvial soils
fertilizers, 2324
leaves, 592
phosphorus, 2324
soil properties, 363
Uttar Pradesh, 363
Venezuela, 592, 2324

Aloe vera
antifeedant property, 3156
Eutectona machaeralis, 3156

Alternaria tenuissima
conidial germination, 619
lapachol, 619

Aluminium
extractives, 4370

Aluminium tolerance
clones, 992

Amazon
podzolization, 3291
species trials, 1120

Ambrosia fungi
Ascoidea Africana, 2701
Ascoidea asiatica, 2701

America
afforestation, 1838
birds, 158
chemical composition, 606
density reduction, 2079
distribution, 1275
extractives, 606
growth rate, 3424
growth, 1995
moisture absorption, 4160
plantations, 1995, 2079
pulping catalysts, 606
regeneration, 1275
silviculture, 1275
timber quality, 4160
wood properties, 4622

Amino acids
leaves, 620

Amitermes evuncifer
crops, 3060
natural resistance, 4475

Ammonium sulphate
fertilizers, 2285

Amphibelondira bhutanensis
Bhutan, 506

Amsacta albistriga
Hyblaea puera, 3181
nuclear polyhedrosis virus, 3181

Amylases
decomposing fungi, 449
leaf litter, 449

Amylosporum campbellii
root rot, 2781

Anamalai
regeneration, 1245

Anatomy, 733
annual rings, 672, 683
bark, 733
caout chouc, 630
fibres, 4108
growth rings, 689
leaves, 681
phenology, 676
phloem rays, 698
seasonal variation, 733
sieve elements, 698
sulphur accumulation, 2586
wood properties, 4014, 4097
xylem, 630

Andamans, 1186
deciduous forests, 1939
exotics, 1085
management, 3863
mechanical properties, 4248
monoculture plantation, 231
mortality, 298
plantation raising, 1939
plantations, 1186, 1950
silviculture, 1911
soil degradation, 231
soil properties, 298
yield, 1186

Andhra Pradesh, 89, 133, 225, 448, 483, 652, 653, 654, 737, 1004, 1207, 1498, 1656, 1704
aerial photographs, 3263
clones, 1004
dendroclimatology, 737
fertilizer trials, 2284
forest types, 1098
fungi, 448
genetic improvement, 46, 954
Hyblaea puera, 3032, 3033
in vitro propagation, 1778
intercropping, 2378
international programmes, 1005
investments, 1947
irrigated plantations, 1947
Nallamalais, 3853, 3854
plantations, 225, 2237
plus trees, 954
progeny trials, 46
provenance trials, 1005
seasonal distribution, 3032, 3033
seed germination, 1408, 1498, 1778
seed orchards, 954
silviculture, 2067, 2118
survey, 3263
teak forests, 1207, 3767
vesicular arbuscular mycorrhizae, 483

Angul
regeneration, 2164
weeding, 2164

Animals
logging, 2533

Annamlai
management, 3848

Annual increment
increment borer, 3556

Annual rings, 672, 678, 683
age, 3471, 4139, 4140
crown diameter, 3471

Anomala
nurseries, 3213

Anoplolepis longipes
predator ants, 3196
Xyleutes ceramica, 3196

Antelope habitat
Tanzania, 2678

Antheraea mylitta, 2967

Anthesis
pollination, 808

Anthia sexguttata

Hyblaea puera, 3166
Pyrausta machaeralis, 3166

Anthocoptes tectonae, 3001

Anthraquinone naphthoquinone
leaves, 568

Anthraquinones
antitermite properties, 3206
extractives, 4355, 4384
pulping, 4727
termite resistance, 4516
wood chemistry, 626, 4302, 4355

Anti-diarrhea
Indonesia, 612
medicinal properties, 612

Antibacterial triterpene acids
cell culture, 4330

Antibiotic effect
Ocimum kilimandscharicum, 2393

Antifeedant property
Eutectona machaeralis, 3156, 3211
Lantana camara var. *aculeata*, 3156

Antimutagens
Philippines, 623

Antitermite properties
anthraquinones, 3206

Ants
Anoplolepis longipes, 3196
predators, 3196
Xyleutes ceramica, 3196

Apate
Ghana, 2820

Apenteles machaeralis, 3141

Aphelenchoides composticola
toxicity, 587

Aphis gossypii
Kerala, 3000

Aphis tectonae, 3044

Arboricides
weed control, 2662

Arbovirus vectors
Nigeria, 57

Arbuscular mycorrhizae
seedling growth, 517
spore population, 482
symbiotic efficiency, 508

Arbuscular mycorrhizal association
Kerala, 498
productivity, 498
seedlings, 507

Architectural analysis
agroforestry, 2357
Kerala, 2357
mixed plantations, 2365

Architecture
agroforestry, 2356
home gardens, 2356

Argentina
plantation establishment, 1809
provenance trials, 1079
seed processing, 1550

Arisobia birmanica, 2834

Armillaria mellea
Africa, 2726

Armillaria root disease
Nyasaland, 2718

Arthropod fauna
leaves, 429
litter decomposition, 429

Artificial regeneration, 1253, 1259, 1280, 1287, 1299, 1300, 1314, 1315, 1317, 1321, 1324, 1328, 1370, 1240, 1324, 1329, 1381, 1618
Bangladesh, 530
Bengal, 1304, 1304
Bihar, 1348
Burma, 1317
Burning, 1298
clear felling, 530
cultivation, 1937, 1938
dry forests, 1329
Dutch East Indies, 1937
India, 1235
Karnataka, 1269, 1270
Madhya Pradesh, 1280
Madras, 1381
Maharashtra, 1270
Myanmar, 1250, 1253, 1259, 1314, 1315
Netherlands, 1938
plantation techniques, 2075
plantations, 1270
planting stock, 1618
research, 1381
soil erosion, 530
soil nutrients, 1298
sowing, 1296, 1387
split stumps, 1241
stump planting, 1235, 1618
stumps, 1241
Tamil Nadu, 1235, 1381

Artocarpus hirsuta
thinning, 2462
underplanting, 2462

Arunachal Pradesh
Bischofia Javanica, 4157
germplasm, 1019
soil properties, 358

Ascoidea Africana
ambrosia fungi, 2701

Ascoidea asiatica
ambrosia fungi, 2701

Ascomycetes
Podospora nannopodalis, 2782

Ascorbic acid
adventitious rhizogenesis, 1675

Ash
leaves, 591
nutrients, 591

Asia, 3, 3900, 4188
exports, 3900
management, 2108
quality seeds, 1484
silviculture, 2108

Asia pacific, 1140
afforestation, 3822
grading rules, 4588
management, 3822
resources, 1142

Aspergillus flavus
Hyblaea puera, 3149

Aspergillus
litter decomposition, 454

Aspergillus niger
growth enhancement, 519

Asphondylia tectonae
gall midge, 2863
syntomernus, 3180

Assam, 1186
borer beetle, 2986
Canarium strictum, 4280
giant timber, 3423
insect pests, 2987
mistletoe, 2654
plantations, 514, 1186

vesicular arbuscular mycorrhizae, 514
yield, 1186

Assessment
Myanmar, 3674

Aularches miliaris, 2813
defensive mechanism, 2929

Aularches scabiosae
biochemistry, 2927
leaves, 2927

Australia, 625, 968, 2875
afforestation, 1912
industry, 3962
Laos-Australian reafforestation, 1888
mine restoration, 1912
nutrient tests, 625
Octotoma scabripennis, 2911
plantation grown teak, 4096
plantation management, 2204
provenance trials, 968
seed germination, 2204
termites, 2875
weed control, 2911

Autotropis modesta, 2979

Auxins
rooting, 1761

Avenue plantation
Malaya, 1844

Azadirachtin
Hyblaea puera, 3203

Azospirillum
vesicular arbuscular mycorrhizae, 513

Azotobacter inoculation
biomass production, 504

B-horizon
soil properties, 323

Bacillus megatherium, 520

Bacillus thuringiensis
biological control, 3140, 3147, 3148, 3152, 3168
Eutectona machaeralis, 3140, 3152, 3165
Hyblaea puera, 2903, 3093, 3161, 3168, 3221
Thailand, 2903

Bacterial action
seed treatment, 1563

Bacterial diseases
Malaysia, 2746

Bacterial pathogens
Bacillus thuringiensis, 3093
Enterobacter aerogenes, 3093
Hyblaea puera, 3093
Pseudomonas aeruginosa, 3093
Serratia marcescens, 3093

Bacterial wilt
fungus diseases, 2748, 2769
Pseudomonas solanacearum, 2700
Pseudomonas tectonae, 2757
seedlings, 2700, 2715, 2769

Baculovirus
biological control, 3190
Hyblaea puera, 3173, 3190

Bagelen
agri silviculture, 1377

Baikiaea plurijuga
wildlife damage, 1896
Zambia, 1896

Bamanpokri teak plantations
mixed plantations, 1859

Bamboo
mixed forests, 1356
mixed plantations, 1237, 1330, 1342, 1966, 2402, 2403, 2404, 2471
Myanmar, 1378, 1383, 1384, 1389, 2403, 2404, 2471
natural regeneration, 1248, 1316, 1330, 1356
plantations, 2373
Pyinmana forest division, 1330, 2404
regeneration, 1237, 1342, 1378, 1383, 1384, 1388, 1966
sowing, 1389
weed control, 2658
yield, 3285

Bambusa arundinacea
ecological studies, 2355
mixed plantations, 2354, 2355

Bamonpokri teak plantations
plantation raising, 2004
site factors, 2004

Bangladesh, 3, 482, 489, 530, 1403, 1404, 1774, 2822, 2826, 2862, 3127, 3282, 4105, 4565
afforestation, 1827
arbuscular mycorrhizae, 482
bacterial wilt, 2700
breeding programmes, 1480
defoliation, 2824
growth, 2381, 2824, 3282
host plants, 2823
Hyblaea puera, 2823, 2824, 2825, 2826
identification key, 4105
insect pests, 2821, 3127
loranthaceae, 2626
management, 2826, 3765, 3852
mistletoe, 2626
mixed plantations, 2381
moisture content, 4565
nurseries, 1642
plantation establishment, 1956
plantations, 265
polybag size, 1646
population dynamics, 2825
prices, 3931
productivity, 3364
profitability, 3765
Pseudomonas solanacearum, 2700
regression technique, 3367
rotation, 2198
seed germination, 1403, 1404, 1503
seed orchards, 265, 1480
seed production, 1503
seed storage, 1503
seedling growth, 1646
seedlings, 1642, 2700
shrinkage, 4261
soil erosion, 528, 530
soil fungi, 482
soil properties, 265
soil types, 2381
spore population, 482
stump size, 1643
termites, 2862
thinning, 2135
vegetative propagation, 1774
volume tables, 3329, 3366, 3367
wood anatomy, 4105
yield, 3407

Bankia admondsonii, 2827

Bantam
agroforestry, 1065

Bark, 4090, 4110, 4165, 4178
anatomy, 733

chemical composition, 576, 4327
fibre length, 4094
mercury, 4178
oxalic acid, 4306
pulping, 4757
seasonal variation, 733
specific gravity, 4165

Bark thickness, 3517

Barkwood, 4118

Barrels, 4759

Basal area, 3441, 3479, 3512, 3525, 3566, 3580

Basic density
heartwood content, 3478

Basic experience
Myanmar, 3729

Beauveria bassiana, 3025, 3040, 3041, 3129, 3183, 3185
biological control, 2901, 3040, 3129
Xyleutes ceramica, 2901

Beauveria tenella, 3072

Beehole borer, 2837, 3120, 3139
aeolesthes, 2912
Beauveria bassiana, 2901
biological control, 2901, 3139
Myanmar, 2837
Thailand, 2901, 2902
Xyleutes ceramica, 2849, 2894, 2901, 3139

Belgium
productivity, 3676
strength properties, 3997

Belt sanding, 4391

Bending, 667

Bending behaviour, 4411

Bending properties
furniture, 4747
heat treatment, 4566
moisture content, 4260

Bending strength
laminated wood, 4335

Bengal, 1304, 2699
diseases, 2736
evergreen forests, 253, 254
plantation techniques, 1630
plantations, 253, 2082
podzolization, 253
productivity, 3349
silviculture, 2082
soil properties, 198, 253, 254

Benin, 3022
plantations, 242, 1999
soil nutrients, 88, 242
soil properties, 242, 243
understorey, 127

Berkman's yield table, 3406

Betul division
single stem silviculture, 2221

Bhutan
Amphibelondira bhutanensis, 506

Bibliography, 8, 9, 3713
diseases, 3010
FAO, 19
Indonesia, 3010
insect pests, 3010
marine borers, 3061, 3062
Perlis, 247
soil properties, 165, 247
Thailand, 18

Bihar, 558, 1348, 3810
insect pests, 2802
nematodes, 472
parasites, 472
plantations, 1186
site classification, 400
soil properties, 400, 401
survey, 472
yield, 1186, 3683

Biochemical cycling
nutrient conservation, 439

Biochemical diversity
Hyblaea puera, 3004

Biochemistry
Aularches scabiosae, 2927
cell wall, 4315
extractives, 4367, 4369
leaves, 2927

Biocontrol
collar rot, 2764, 2766
Hyblaea puera, 3132
Sahyadrassus malabaricus, 3132

Biodiversity
genetic resources, 802
Maharashtra, 1942
Nepal, 20
teak forests, 132
Thailand, 2375

Biofertilizers
moisture conservation, 2321
vesicular arbuscular mycorrhizae, 2268

Biological control, 3133, 3155
Aspergillus flavus, 3149
Bacillus thuringiensis, 3140, 3147, 3148, 3152, 3168
baculovirus, 3190
Beauveria bassiana, 2901, 3040, 3129
beehole borer, 2901, 3139
defoliation, 2917, 3135, 3136, 3142, 3154, 3162
entomopathogens, 3150
Erythmelus empoascae, 3157
Eutectona machaeralis, 2948, 3040, 3129, 3140, 3152
fusarium, 3129
Hapalia machaeralis, 3137, 3138
Hyblaea puera, 2948, 3040, 3129, 3131, 3137, 3138, 3149, 3150, 3158, 3168, 3170, 3171, 3172, 3189, 3190, 3193
insect parasitoids, 3170
insect pests, 2917, 3168
Lantana camara, 2659
Leptobyrsa decora, 2659, 2995
Lygropia quaternalis, 3137
Metarhizium anisopliae, 3150
microbial pathogens, 3131
Nectarinia asiatica, 2665
Nemeritis tectonae, 3139
nuclear polyhedrosis virus, 3172
Palexorista solennis, 3193
Paliga damastesalis, 3147, 3148
parasites, 3137, 3138, 3139
parasitism, 3158
parasitoids, 3189, 3193
Pontanus puerilis, 3157
Sahyadrassus malabaricus, 3131
sylepta, 3137
Sympiesis hyblaeae, 3193
undergrowth, 3136, 3154
weeds, 2665
Xyleutes ceramica, 2901, 3139, 3146

Biomass, 3324, 3385, 3386, 3452, 3469
carbohydrate content, 656
fertigation, 2302, 2303
harvesting, 375
irrigation, 2302

nutrients, 375, 2180, 3442, 3444
phytosociology, 1075
productivity, 3451
roots, 656
soil nutrients, 264
spacing, 2180
weight, 3384

Biomass estimation, 3443, 3474

Biomass production, 417, 3328, 3408, 3442, 3503, 3450
azotobacter inoculation, 504
mine restoration, 1925
nutrient requirements, 3450
site factors, 3415
soil chemistry, 276
thinning, 3461

Biotechnology, 1685
genetic improvement, 1759

Biotope
Landolphia calabarica, 128
Lecaniodiscus cupanioides, 128
understorey, 128

Bird predators
Hyblaea puera, 3197

Birding
pratapgarh teak forests, 159

Birds
America, 158
fruit damage, 1483
Indonesia, 160
mammals, 1483
Panama, 158
Papua and New Guinea, 150
teak forests, 160

Bischofia Javanica, 4157

Bismarck-archipelago
teak forests, 1056

Biza orellana
undergrowth, 2383

Bleaching, 4407

Block boards, 4681

Blunting, 4222

Boats, 4292

Bole diameter
thinning, 3401, 3533

Bolivia
seed processing, 1550
weathering, 4297

Bomanpokri teak plantation, 3787

Bombay
afforestation, 1829
regeneration, 1230

Bombycidae
food plants, 3069

Bond strength
extractives, 4321

Bonding quality
laminated wood, 4715

Bonding, 4402

Borer beetle, 2986

Borers, 2900

Bori reserve
fire protection, 2571

Bori teak
rotation, 2201

Botanical composition, 83
stand density, 145

Botany, 549, 558

Botryodiplodia theobramae
collar rot, 2787

Boucherie process
preservative treatment, 4555

Boundary layer conductance
leaves, 642

Brachymeria euploeae
Hyblaea puera, 3195
parasites, 3195

Brachymeria lasus
Eutectona machaeralis, 3090
Hyblaea puera, 3090
natural enemies, 3090

Branch cuttings
vegetative propagation, 1681, 1682, 1749, 1764, 1765, 1779

Branch formation
water cuttings, 2216

Branch tearing
trunk damage, 2587

Branches
fibre length, 4092
specific gravity, 4166
utilisation, 4639
volume determination, 3538
wood properties, 4089

Branching, 150, 696, 962, 2040
light, 648
stump planting, 2069

Brandis system
yield regulation, 3307, 3488

Brazil, 527, 935, 1120, 1422, 1550, 2100, 3414, 4663
country reports, 21
dendrochronology, 736
genetic improvement, 1008
Hyblaea puera, 3035
insect pests, 3035
international effort, 949
machine, 1454
marketing, 21
mixed cropping, 2406
plantations, 21, 1919
podzolization, 3291
provenance trials, 935, 949
seed origin, 4049
seed quality, 1422
silviculture, 1825
soil properties, 527
species introduction, 1107, 1108
species trials, 1120, 1919

Breast height
bark thickness, 3517
diameter, 3517
fluting, 3570
furrows, 3570
plantation grown teak, 3570
sapwood, 3517
stump diameter, 3529

Breeding programmes
Bangladesh, 1480
Thailand, 752

Breeding strategy
seed production, 977

Breeding, 27, 740, 741, 742, 749, 762, 774, 777, 790, 802, 804, 805, 812, 863, 907, 930, 931, 966, 982, 1086, 1565, 1726, 1997, 2467
Cuba, 27
genetic improvement, 738, 770, 775, 794, 795, 806, 807, 812, 850, 863, 904, 912, 926, 966, 967, 982, 1009, 1726
genetic resources, 802
hybrids, 846
India, 758, 773, 775, 795, 797, 966, 982
Indonesia, 764, 766, 794, 1009, 1997
insect resistance, 924

IUFRO, 873
Laos, 907
Myanmar, 907
new variety, 772
Nigeria, 807, 931
Papua and New Guinea, 805, 812, 912
Philippines, 741
progeny trials, 1032
provenance trials, 873, 1039
quality improvement, 745
RAPD variation, 982
Sri Lanka, 1039
Tanzania, 806, 967, 1032
teak improvement, 862
Thai Danish Teak Improvement Centre, 904
Thailand, 740, 743, 762, 767, 770, 785, 862, 863, 930
timber quality, 794
Trinidad, 749
West Africa, 919, 920

British commonwealth
species introduction, 1139

British empire
exotics, 4072

British India, 3943
exports, 3943
marketing, 3557
utilisation, 3557
yield tables, 3521

Bud grafting
growth, 1777
planting stock, 1788
rooting, 1719

Bud trace connections, 704

Bud wood
storage, 1721, 1722

Budding, 749, 965, 1713, 1727, 1728, 1763, 1776, 1794
clonal propagation, 1794
humidity, 1794
macropropagation, 1763
planting stock, 1716
vegetative propagation, 749, 1688, 1712, 1716, 1729, 1773, 1774, 1775, 1795

Buds
vegetative propagation, 1631

Building constructions
durability, 4635

Buildings
structural timber, 4575

Bulgaria
industry, 4427

Bulk density
root growth, 384
soil density, 384

Burma (*see also* Myanmar, 262, 1239, 1286, 1303, 2350, 2495, 2789, 3881, 4285, 4339
artificial regeneration, 1317
borers, 2900
burning, 1277
caout chouc, 4339
defoliation, 2789, 2791
ecology, 1054
exotic plantation, 2065
felling, 1050, 1051, 2484
fire protection, 2589, 2590, 2592, 2602, 2604
fires, 1318
giant timber, 2366
girdling, 2495, 4012
grading, 4592
harvesting, 2485, 2509, 2513, 2527
industry, 3953
management, 3824
mechanical properties, 4285
mechanization, 2527
mixed planting, 2391
natural regeneration, 1239, 1284, 1286, 1303, 1317, 1318
physical properties, 4285
plantations, 1980, 3695
prices, 3881
properties, 3968
regeneration, 262, 1276, 1277, 2350, 2484
reproduction, 1276
royalty, 3587, 3702
seed germination, 1394
seed treatment, 1394
shifting cultivation, 2350
silviculture, 1200, 4768
soil properties, 262
spacing, 1978
stump planting, 1286, 1979
taungya system, 2350
taungya, 2359, 2484
thinning, 2114
timber quality, 4235
trade, 3909, 3910
utilisation, 3968
weeding, 1980
wood properties, 4035, 4235
Xylia dolabriformis, 2391

Burning, 1277, 1298
environmental impact, 309
grass, 1988
growth, 1987
insect pests, 309
plantations, 2053
planting area, 1976
regeneration, 339, 1277
soil nutrients, 1298
soil properties, 339
teak forests, 2053

Butt rots
roots, 2710, 2758

Buttress height, 3315

Calamus simplicifolius
mixed planting, 2482

Calcicole, 299

Calcium carbonate
seed germination, 1551

Calcium, 281
heartwood, 692
leaves, 210
seed germination, 1445
soil properties, 209, 210, 281, 402

Calesterna scabrator, 3065

Calli induction
flowers, 1696

Callus
fungicides, 608

Calopepla leayana, 3185

Calorific value, 4444, 4447

Calotermes tectonae, 2832, 2933

Cambial activity
juvenile wood, 673

Cambial anatomy
seasonal variation, 699

Cambium
plastid ultrastructure, 4106
wood anatomy, 4106, 4135, 4136

Cambium age
growth rate, 4124

Cameroons
species introduction, 1126

Canada

teak forests, 156

Canal zone experiment gardens, 1872

Canarium strictum, 4280

Canker
flowering twigs, 2779
Fusarium pallidoroseum, 2713
Phomopsis, 2779

Canopy diameter
landsat MSS data, 3454

Caout chouc, 628, 4338, 4339, 4360
decay resistance, 629
xylem, 630

Caparo forest reserve
soil nutrients, 263

Carbohydrate content
roots, 656

Carbohydrates
seasonal variation, 313

Carbon, 361
plantations, 188, 192, 361

Carbon concentration
specific gravity, 4317

Carbon content, 581

Carbon dioxide
global warming, 81, 179
litter decomposition, 463

Carbon fixation
storage, 3353

Carbon sequestration, 177, 372

Carbon storage
age, 4332

Carbonization, 4320

Carcelia kockiana
Hyblaea puera, 3195
parasites, 3195

Caribbean, 3387
agroforestry, 2448
bibliography, 3713
investments, 3712
management, 3713
site classification, 94

Carriage, 4616

Carving behaviour, 4422

Cash crops
intercropping, 2413
undercrops, 2436

Cassia stamea
mixed plantations, 2428

Cattle
fodder, 4734

Cattle manure
seedlings, 2269

Cell culture, 1743, 4330

Cell division
vascular cambium, 712

Cell wall
biochemistry, 4315
water soluble substances, 4311

Cellulolytic microorganisms, 488, 489

Cellulose
durability, 4101

Cellulosic materials
chemical properties, 4664

Cement board
wood veneer waste, 4689

Cement bonded woodwool boards, 4667

Central America, 94, 1140, 1146, 3387
bibliography, 3713
investments, 3712
management, 3713
silviculture, 1205
site classification, 94
site quality, 92

Central provinces
forest types, 1089
regeneration, 1327, 1373

Certification
India, 4605

Ceylon (*see also* Sri Lanka), 1468
cultivation, 1081
mixed plantations, 1172
plantations, 1967

Chaconia tectonae
rust, 2763

Chaenus rayotus
Hyblaea puera, 3143

Chambal ravines
afforestation, 1867

Charcoal
anti-diarrhea, 612
calorific value, 4433
chemical properties, 4437
sawdust, 4431, 4442, 4443

Chattisgarh
Maniram teak plantation, 3844

Chemical analysis
leaves, 570
phosphatase test, 625

Chemical composition, 256, 468, 566, 571, 606, 613, 619, 2393, 3052, 4304, 4312
bark, 4327
extractives, 590, 606
foliar constituents, 582, 613
lapachol, 619
leaves, 407, 409, 613
litter, 424, 468
mineral concretion, 593
natural durability, 590
roots, 598
silage, 409
tectoquinone, 569
wood chemistry, 4328

Chemical control, 2882, 4537
defoliation, 3214
Dendrophthoe falcata, 2645
economic assessment, 3214
herbicides, 2207
Holotrichia insularis, 3224
Holotrichia serrata, 3198
mildew, 2740
mistletoe, 2632, 2633, 2646, 2647, 2648
Neotermes tectonae, 3207
trunk injection, 2632, 2648
weed control, 2630
weedicides, 2646, 2648

Chemical properties, 314, 325, 379, 4042, 4319, 4345, 4361, 4389, 4412
cellulosic materials, 4664
charcoal, 4437
chromatographic analyses, 4358
dehydrotectols, 4365
extractives, 4179, 4326, 4334, 4340, 4347, 4348, 4349, 4350, 4358, 4382, 4385
extracts, 4324
flavonoids, 4348
fluorescence spectroscopic study, 4349
foliar composition, 614
food colourants, 4329
formaldehyde, 4309, 4310
heartwood, 4324

hydroxylapachol, 4331
insecticides, 4353
mineral inclusions, 4357
nutrients, 614
old wood, 4042
pesticide, 4347
quinones, 4366
soil biology, 267
soil nutrients, 379
soil organic matter, 379
tectols, 4365
tectoquinone, 4305, 4353
termite resistance, 4358
wood extractives, 4376

Chemical resistance, 4481

Chemical treatment
sawdust, 4557

Chemicals
aerial spraying, 3222
Hyblaea puera, 3222
weed control, 2664

Chilling
seed germination, 1544

China, 1047, 3996, 4569
clones, 992
genetic improvement, 40, 956
genetic value, 861
genetic variation, 955
international cooperation, 16
plus trees, 955
productivity, 3379
provenance trials, 861, 955, 1047
research, 40
seed germination, 1501, 1599
silviculture, 16, 40
site classification, 98

Chipboards, 4707

Chittagong hill tracts
mixed plantations, 2412
natural regeneration, 1244

Chlorophyll
nutrient deficiency, 572

Chlorophyll deficient seedling, 1401

Chlorophyll synthesis
clones, 660

Chromates, 4352

Chromatographic analyses
extractives, 4358
wood properties, 4055

Chromolaena odorata, 2670

Chromosome, 792

Classification, 4614
exports, 4613
keen's method, 4609
strength properties, 4602

Clay content
soil properties, 364

Clay minerals
soil chemistry, 200, 327

Clay minerology
soil properties, 238

Clear cutting, 2543

Clear felling, 2504
regeneration, 530, 2514
soil erosion, 530

Cleavage properties
strength properties, 4268

Climate, 2005
dendrochronology, 718, 725, 729
growth rings, 718, 729, 4099
timber quality, 4002

Climatic factors
growth, 4143
litter fall, 450
wood properties, 4143

Clonal forestry, 1674

Clonal identification
isoenzymes, 782

Clonal origin
Java, 975

Clonal propagation, 1710, 1771, 1787
budding, 1794
grafting, 1794
IBA, 1720
Malaysia, 1754, 1755
planting stock, 1754, 1770
rooted cuttings, 1720, 1755

Clonal resistance
defoliators, 4485
Eutectona machaeralis, 4455, 4490, 4491, 4506, 4508, 4509, 4510
foliar protein, 4484
Hyblaea puera, 4492, 4493
insect pests, 4483
nutrient contents, 4507
Olivea tectonae, 4489
Paliga machoeralis, 4484
rust, 4489
Spodoptera litura, 4507

Clonal seed orchard, 965, 986, 3063, 4030
flowering, 815
Indonesia, 990, 991
low fruit production, 896
seed production, 990

Clonal variation, 1000, 3047
reproductive traits, 899, 1036
seed germination, 1516

Clones, 518, 660, 686, 761, 858, 891, 927, 1785, 2662, 2863, 2928, 3478, 4198, 4485
acid tolerance, 992
aluminium tolerance, 992
Andhra Pradesh, 1004
Arunachal Pradesh, 1019
China, 992
clonal propagation, 1754
clonal resistance, 4485
fertilization, 822
field performance, 1692
flowering, 763
fruit variation, 900
fruiting, 897
gall midge, 2863
genetic improvement, 856, 889
genetic variation, 897, 1019
germplasm, 1019
growth, 889, 927, 1004, 3478
heartwood content, 3478
heritability, 891, 4197
India, 992
Indonesia, 822
Karnataka, 897
Kerala, 4198
Madhya Pradesh, 518, 889, 1785
Maharashtra, 761, 959
Malaysia, 1754
Nigeria, 992
planting sites, 856
planting stock, 1754
pollination, 822
progeny testing, 761, 959
rooting, 1691
shoot growth, 660
wood density, 4197, 4198

Cloning
plus trees, 1701

Clypeolella tectonae, 2785

Coal mine areas
reclamation, 1884
Coastal areas
planting, 1917
volume tables, 3540
Coccids
saplings, 2934
Cochin China
wood properties, 3988
Coelosterna
sapling borer, 3109
Coffee plantations
mixed cropping, 2384, 2406
Coir peat mulch
fertilizers, 2091
Coleoptera, 3089
Collar rot
biocontrol, 2764, 2766
Botryodiplodia theobramae, 2787
fungicides, 2764, 2766
Rhizoctonia solani, 2689, 2764, 2765, 2767
seed treatment, 2767
seedlings, 2689
Colombia, 4162
bibliography, 3713
investments, 3712
management, 3713
site classification, 94
Colonisation
arbuscular mycorrhizae, 482
Colouring matter
tectoleafquinone, 567
COMAP model
greenhouse gas, 76
Commercial timbers
wood properties, 4065
Community forestry
Sri Lanka, 2439
Composite products, 4692
Composition
lead, 315
Compost
cattle manure, 2269
NPK fertilizers, 2269
Compressive strength, 4200
Condensation effect
dehumidification kiln, 4568
Conductivity
dielectric properties, 4193
Congo
agriculture policy, 529
deforestation, 1144
soil conservation, 529
Conidial germination
Alternaria tenuissima, 619
lapachol, 619
Coniella
litter decomposition, 454
Conjointed quadruplet seedling
morphology, 708
Conolly teak plantations
Kerala, 3747
Conservation
India, 982
Indonesia, 3860
Siam, 3941
Consortium support model
sustained yield, 3388
Construction
industry, 3894
joints, 4392
utilisation, 4618
Container seedlings
transplanting, 1645
Containers
stumps, 1626
Control
Bacillus thuringiensis, 2903
Hyblaea puera, 2881, 2903, 3171
insect pests, 2835, 2842
Conversion
investments, 3727
Karnataka, 3727
Cooperage woods
seasoning, 4559
Coorg
plantations, 962, 3774
Copper
extractives, 4370
soil chemistry, 296
Copper belt
teak forests, 1896
Coppice crop
thinning, 2182
Coppice forest
growth, 3412
Coppice regeneration, 1323
Coppice shoots
seed orchards, 1006
Coppice stands
thinning, 2197
Coppice system
Madhya Pradesh, 2233
Coppice,
regeneration, 1232, 1380
seedlings, 1232, 1843
shoot cuttings, 1802
silvicultural systems, 2049
single stem silviculture, 2221
thinning, 2064, 2221
Coppiced plantations
management, 2002
Coppicing, 3074
chemical control, 2207
natural regeneration, 1322
seasonality, 2034
thinning, 1374
Coptotermes curvignathus, 3099
Indonesia, 2947
Malaya, 2947
Coptotermes formosanus, 2855
natural resistance, 4473, 4479
Coptotermes havilandi, 2946
Coptotermes heimi
Madhya Pradesh, 3049
natural resistance, 4466
Coral soils
afforestation, 1860
Corcyra cephalonica
Hyblaea puera, 3030
insect rearing, 3030
Corticium Javanicum
fungal diseases, 2691
Corticium salmonicolor
fungal diseases, 2691
Corticium Javanicum, 2732
Cossid pests, 2970
Cossus cadambae, 2960, 2972, 3080
Kerala, 2977
microbial pathogens, 3163
Cost benefit analysis
afforestation, 3681
rotation, 2127
Costa Rica, 59, 60, 100, 979, 1146, 1219, 1500, 1946, 2170, 2185, 2190, 2388, 3324, 3431, 4003, 4175, 4223

afforestation, 1869, 2190
agroforestry, 2388
cultivation, 1900
economics, 3843
ecotones, 137
fertilization, 2283, 2313
investments, 3642, 3701, 3775, 3782, 3783
plantation establishment, 1869, 1900, 1946
plantation evaluation, 3413
plantations, 1922, 2170
productivity, 1900, 3325
profitability, 3599
seed banks, 1407
seed certification, 1500
seed orchards, 979, 3413
silviculture, 1219, 3782
site index, 100
site quality, 3550
species trials, 1146, 1929
sustainable management, 3783
timber quality, 2205, 4003
understorey, 137
volume estimation, 3323, 3459
wood density, 4223
yield, 3295, 3550, 3642

Costing system
logging, 2525

Costs, 3646

Costus speciosus
allelopathy, 601

Cote d'ivoire, 1184, 1850, 2365
afforestation, 1850
dris evaluation, 88
genetic variation, 779, 780
intensive management, 3834
investments, 3743
isozyme variation, 779
marketing, 3743
mating system, 780
mixed plantations, 2365
plantation grown teak, 1184
provenance trials, 935
reforestation, 1850
silviculture, 1184
site quality, 88
stand management, 3825
yield, 88

Cotyledon number
phyllotaxy, 664

Country reports
Brazil, 21
Dahomey, 29
France, 29
India, 29, 35, 49, 1458
Indonesia, 29, 50
Japan, 29
Laos, 29
Malaysia, 37, 51, 2133
Mozambique, 26
Myanmar, 29, 32
Nepal, 20
Sri Lanka, 23
Thailand, 22, 29, 36, 48, 3684
Tobago, 45
Togo, 29
Trinidad, 45
Vietnam, 43
World, 25

Cover crops, 135, 2394

Crassulacean acid metabolism, 627

Creamery churns, 4070

Creeping behaviour
wood properties, 4167, 4279

Crematogaster traubi var. *vastatrix*, 2804

Crematogaster
predators, 3196
Xyleutes ceramica, 3196

Cremnops atricornis, 3177

Creosote
durability, 4468

Crop productivity
soil properties, 234

Crop rotation
field trials, 2009

Crops
Amitermes evuncifer, 3060
light tolerance, 79
termites, 3060

Cross grain
mechanical properties, 4286

Crotoleria
crop rotation, 2009

Crown, 1433, 3396
age effect, 3460, 3471
basal area, 3566
diameter, 3401, 3476, 3520, 3533
diameter at breast height, 3363, 3422, 3427, 3473, 3476
growth modelling, 3422
height, 3476
plantation grown teak, 4137
spacing, 2214
thinning, 3401
wood anatomy, 4137

Crushing strength
extractives, 4183

Crushing stress
specific gravity, 4132

Crustaceans
marine borers, 3078

Cryopreservation, 1731

Cryptotermes
Indonesia, 2943

Cryptotermes bengalensis, 3106

Cryptotermes brevis, 3227

Cryptotermes cynocephalus, 3099

Crystallinity
chemical properties, 4345

Cuba, 416, 1550, 1695, 1698, 1767, 2384, 2809, 4097
breeding, 27
Draeculocephala cubana, 2965
forestry research, 27
management, 2159
plantation techniques, 2159
policy, 4773
provenance trials, 910
species trials, 27
teak forests, 101

Culling
planting stock, 1665

Culm cuttings
root formation, 1718
vegetative propagation, 1756

Cultivation, 268, 1809, 1843, 1851, 1854, 1897, 1900, 1914, 1923, 1928, 1937, 1938, 1940, 1964, 2009, 2318, 2389, 2442, 3011, 3562
afforestation, 1830, 1831, 1832, 1833, 1955
Africa, 1901
agroforestry, 2369, 2427, 2458
Argentina, 1809
Ceylon, 1081
Costa Rica, 1900

Dutch East Indies, 1937
economics, 2369, 2447
farm forestry, 2447
France, 1831
Germany, 1851
Gujarat, 1918
Indonesia, 1823, 1824, 1836, 1855, 1940, 2445, 2458, 3586
intercropping, 1926, 2389, 2458
Java, 1803, 1805, 1812, 1822, 1836, 1852, 1935, 1940, 1957, 2338, 2445
Jivrajbhal patel agroforestry, 1918
Madura, 1852
Malaysia, 1964
mixed plantations, 2442, 2445
Myanmar, 1923
Netherlands, 1804, 1938
Panama, 1331
plantation techniques, 1918
plantations, 1803
planting, 1852
ploughing, 1955
productivity, 1900
Punjab, 2369
seminar proceedings, 1964
statistics, 3586
Tamil Nadu, 2447
taungya, 2338, 2458
teak forests, 1886
underplanting, 2338
Venezuela, 1926, 1928
weed control, 2103

Culture technique
vegetative propagation, 1680

Cutting cycle
teak forests, 2503

Cutting force
rotary cutters, 2531

Cutting methods
thinning, 2227

Cutting resistance
mechanical properties, 4241

Cuttings
propagation, 1744
rooting, 1740
stumps, 1620
vegetative propagation, 1740, 1751

Dahomey
country reports, 29
silviculture, 1174, 1206, 3641
wood defects, 2576
yield, 3641

Damage
elephant damage, 2677

Damasces
utilisation, 4620

Damascsche
teak forests, 3653

Dangs forest
composition, 315

Danida Forest Seed Centre
International effort, 949
provenance trials, 949

Danish Thai Teak Improvement Centre
genetic improvement, 1225

Darjeeling Himalaya
taungya, 2450

Data bank
Kerala, 3373

Database
management, 3661

Decay resistance, 4457, 4458, 4460, 4470, 4513, 4548
caout chouc, 629
extractives, 4356, 4504, 4533, 4534
heartwood, 4356
juvenile wood, 4462
plantation grown teak, 4462
Polyporus versicolor, 4532, 4533
Polystictus versicolor, 4498
Poria monticola, 4532, 4533
wood chemistry, 629

Decay test, 2788

Decay, 2875, 3074, 4550
Polyporus zonalis, 2778
quality assessment, 4067
resistance, 2742

Deccan plateaux
natural regeneration, 1352

Deciduous forests
plantation raising, 1939

Decking, 4659

Decomposing fungi
amylases, 449

Decomposition
leaves, 420, 430, 448

Decorative plywood, 4679

Decorative properties
timber quality, 794

Deer menace
plantations, 2674

Defensive mechanism
Aularches miliaris, 2929

Deficiency
nutrients, 306, 404

Defoliation, 2789, 2795, 2813, 2824, 2858, 2859, 2917, 2930
biological control, 2917, 3135, 3136, 3142, 3154, 3162
Burma, 2789, 2791
chemical control, 3214
clonal resistance, 4485
clones, 2928, 4485
economic assessment, 3214
epicentres, 3019, 3191
Eurema hecabe, 2989
Eutectona machaeralis, 2950, 3016
growth, 2824, 2840, 2841, 2853
Hapalia machaeralis, 2813, 2854
Hyblaea puera, 2813, 2824, 2854, 3008, 3015, 3016, 3017, 3019, 3160, 3191
Indonesia, 2939
insect pests, 2917, 3009
juvenile wood, 4129
Karnataka, 2852, 2950
Kerala, 3008, 3019
lantana bug, 2898
Madhya Pradesh, 2993
Malaya, 2989
migration, 3017
Myllocerus subfasciatus, 2950
Pavonia odorata, 3160
Pavonia zeylanica, 3160
population dynamics, 3016
review, 2980
seasonal incidence, 3015
seedlings, 2795, 2853, 2854
Teleonemia scrupulosa, 2898
Thailand, 2917
understorey, 3136, 3154, 3160
wood anatomy, 4129

Deforestation
Congo, 1144
forest policy, 4776

Degraded forests
agroforestry, 1906
greening, 1878
Myanmar, 1898
Orissa, 1369
Philippines, 1932
Rajasthan, 2158, 2225
rehabilitation, 1882, 1898, 1906, 2158, 2225
social forestry, 1906
species trials, 1932, 1963
Thailand, 1963
vegetational analysis, 1369

Degraded land
plantations, 393

Degraded soil
afforestation, 1949

Dehra Dun
nurse crops, 135
parasites, 2692
plantations, 2394
wood properties, 3967

Dehumidification kiln
condensation effect, 4568

Dehydrotectols, 4365

Delta areas
planting, 1954

Demand and supply
Kerala, 3916, 3917

Dendrochronology, 718, 725, 729, 732
Brazil, 736
growth rings, 718, 726, 727, 729, 731, 4130
Indonesia, 726
Java, 726
Kerala, 727
Puerto Rico, 721
seasonal variation, 736
Thailand, 729, 730, 731, 732
vascular cambium, 736
wood anatomy, 730, 731, 732, 736

Dendroclimatology, 732
Andhra Pradesh, 737
growth rings, 688, 722, 737
India, 737
Indonesia, 688, 723
Thailand, 732
wood anatomy, 732

Dendrophthoe, 2656

Dendrophthoe falcata
chemical control, 2645
parasites, 2645, 2655
weed control, 2644

Denmark, 645
genetic improvement, 947
international cooperation, 928
marketing, 3893, 3911

Density management diagram
yield prediction, 3470

Density reduction
plantations, 2079

Density variation
plantation grown teak, 4209

Density
age, 3705, 4124, 4209

Deoxylapachol
allergy, 4381

Dew
environmental factors, 64

Dharwad
mixed plantations, 2407

Diacrisia obliqua
defoliation, 2813

Diameter at breast height, 3447, 3473, 3476
buttress height, 3315
crown diameter, 3363, 3422, 3427
growth modelling, 3422
height, 3363
rooting, 3397
volume relation, 3409

Diameter distributions, 3309

Diameter estimation, 3527

Diameter
age, 670, 3510
bark thickness, 3517
crown, 3476
height, 670, 3476, 3517
sapwood, 3517
spacing, 2138
thinning, 2138

Dibbling
coppice regeneration, 1323
seed germination, 1578, 1579
sowing, 1528, 1530, 1579

Dichloro diphenyl trichloroethane
wood chemistry, 4556

Dichocrocis punctiferalis
fruit borer, 2935

Dichromates
wood chemistry, 4352

Dieback
Fusarium solani, 2697
Xyleborus similis, 2697

Dielectric properties
conductivity, 4193
wood properties, 4152, 4194

Diflubenzuron, 3202

Digestion
Eutectona machaeralis, 2994
Hyblaea puera, 2994

Dihammus cervinus, 2822, 2907, 2981

Dimensional changes
water soluble substances, 4311
weathering, 4297

Dimensional stabilization
mechanical properties, 4174
moisture content, 4565
sand heat treatments, 4549
stearamidomethylpyridinium chloride, 4180
wood properties, 4173

Dinoderus minutus, 2790

Dinoderus pilifrons
shot-holing, 3134

Diospyros celebica, 2339

Diospyros melanoxylon
mixed planting, 78

Discoloration
dyeing effect, 4428
kiln drying, 4551

Diseases, 2558, 2559, 2569, 2717, 2832
Bengal, 2736
bibliography, 3010
India, 2773
Indonesia, 3010
Java, 2569
Kerala, 2749, 2750, 2775
Malaysia, 2741
nurseries, 2712, 2749, 2750, 2775, 2780
Phassus, 2832
plantations, 2101, 2773, 2775
polyporus, 2736
review, 2569, 2693, 3010
root trainers, 2749
seedlings, 2705

survey, 2559
Thailand, 2559
Tobago, 2760
Trinidad, 2760

Distribution, 47, 73, 107, 705, 1119, 3460
America, 1275
ecological factors, 511
France, 1119
history, 1067
India, 15
Indonesia, 1067
Karnataka, 1068
Kerala, 14
Madhya Pradesh, 55, 1135
Satpuras, 73
South East Asia, 47, 107
teak forests, 1135
Thailand, 3460

DNA markers
plus trees, 1041

DNA techniques
genetic improvement, 1010

DNA transfer
genomes, 983

Dome building
Myanmar, 4634

Dona leaf cups
planting stock, 1606

Dona technique
seedling raising, 1662

Dormancy periods
shoot growth, 654

Dowels
gluing, 4333

Draeculocephala Cubana
Cuba, 2965

Drip irrigation
growth, 2296

DRIS evaluation
yield, 88

Drought
mortality, 2562, 2563, 2568

Drupe characters
seed germination, 1566

Dry deciduous forests
Gujarat, 1153
litter productivity, 445
Madhya Pradesh, 445
Rajasthan, 1153

Dry forests
artificial regeneration, 1329

Dry matter production, 1395, 1748, 3578

Dry monsoon areas
afforestation, 1849

Dry teak
fruit development, 690

Drying properties
seasoning defects, 4187

Drying rate, 4562

Dunctiferalis
saplings, 2934

Duomitus caramicus, 3067

Duomitus ceramicus, 2832
beehole borer, 2837, 2912, 3120
Indonesia, 2924
Myanmar, 2837
Netherlands, 2933

Durability, 4186, 4463, 4465, 4482, 4500
age, 4454
building constructions, 4635
cellulose, 4101
creosote, 4468
decay resistance, 4356, 4457, 4458, 4470, 4513
extractives, 4337, 4343, 4356
fast grown timber, 4087
fuel oil, 4468
furniture, 4429
growth factors, 4471
growth rate, 4472
heartwood, 4356
juvenile wood, 4087
marine borers, 4505, 4520
plantation grown teak, 4449
preservative treatment, 4502
tectoquinone, 4511
termite resistance, 4527
wood chemistry, 4362
wood properties, 4186, 4429, 4595

Dutch East Indies, 3350
cultivation, 1937
management, 3640
silviculture, 1973

Dyeing effect
discoloration, 4428

Dyes, 4723

Dyestuff
leaves, 616

Dying back
natural regeneration, 1349

Dysmicoccus ferris, 2809

Earthworm casts
soil fungi, 493

East India company
trade, 3892

East India, 3879

East indies
marketing, 3557
soil properties, 244
yield tables, 3521

Echthromorpha notularia
Hyblaea puera, 3195
parasites, 3195

Ecological factors
soil fungi, 511

Ecological impact
soil properties, 427

Ecological indicator
biotope, 128
understorey, 128

Ecological studies
Bambusa arundinacea, 2355
mixed plantations, 2355

Ecology, 79, 152, 549, 681, 693, 1064, 1089, 2842,
Burma, 1054
Central provinces, 1089
evergreen forests, 1063
India, 56, 1084, 1090, 1122, 1132, 2842
Madhya Pradesh, 56, 152
Myanmar, 1060, 1063
site factors, 56
succession, 1060
teak forests, 1132

Economic analysis
agrosilvicultural systems, 3785
productivity, 2027
storage, 3353

Economic assessment, 3960
chemical control, 3214
defoliation, 3214
investments, 3800
mixed plantations, 3780

Economic evaluation
agroforestry systems, 2416
mixed plantations, 2407

Economic impact
Mikania micrantha, 2661
plantations, 2661

Economic returns, 3601
investments, 1096
irrigated plantations, 3707
teak forests, 1096

Economics, 12, 947, 975, 3616, 3623, 3652, 3646, 3677, 3699, 3745, 3758, 3759, 3833, 3843, 3850, 3905
afforestation, 1998
agroforestry, 2369, 2423, 2448
agrosilvicultural systems, 2464
cost benefit analysis, 2127
cultivation, 2369, 2447
farm forestry, 2447
financial analysis, 3726
genetic improvement, 947, 1568
harvesting, 2547, 2556
intercropping, 2464, 2479
investments, 3606, 3709, 3725, 3726, 3727, 3730, 3769
irrigated plantations, 2316
irrigation, 2479
management, 1568, 3850
marketing, 3805
plantations, 3730, 3745, 3758
productivity, 3606, 3833
rotation, 2127, 3727
silviculture, 12
sustained yield, 3725
trade, 3905, 3927
yield, 2316, 3726, 3727

Ecophysiology
Dendrophthoe falcata, 2655
host parasite, 2655
water relations, 2655, 2656

Ecosystems, 220, 307, 1055
Darjeeling Himalaya, 2450
soil properties, 220
taungya, 2450

Ecotones
understorey, 137

Ecuador
industry, 3957
investments, 3593

Eczema
allergy, 603, 4386
sawdust, 599
toxicants, 599
tree dust, 603
wood dust, 583

Edaphic conditions
growth, 397
soil properties, 397

Egypt
plantation trials, 2676

El Salvador
erosion, 521
silviculture, 1221

Elasticity, 4204
pulse transmission technique, 4276

Electric moisture meter, 4170

Electric transmission
poles, 4633

Electrical resistance, 4469, 4495

Elephant damage
plantations, 2677

Elephant habitat
teak forests, 156

Elephants
habitat use, 2682
harvesting, 2555
wildlife damage, 2684

Elevation
Hyblaea puera, 2844
Pyrausta machaeralis, 2844

Embryogenesis, 822

Embryogeny, 665

Embryology, 666

Empoasca punjabensis, 3070

Emptiness
fruits, 706, 1436, 1542

Endoclita aroura, 2867

Endoclita gmelina, 2880

Energetics
productivity, 3502

Energy conserving efficiency
productivity, 3284

Energy consumption
thinning, 2168

Enterobacter aerogenes
bacterial pathogens, 3093
Hyblaea puera, 3090, 3093
natural enemies, 3090

Entomopathogens
Hyblaea puera, 3150, 3183

Enugu pitwood plantations
Nigeria, 3764

Environmental conservation
socio economics, 3802

Environmental factors, 60
dew, 64
growth, 59

Environmental impact
burning, 309
Nilambur plantations, 1375
plantation establishment, 75
reforestation, 1913
wood density, 4242

Enzymes, 398, 605

Epicentres
Hyblaea puera, 3019, 3191

Epigeic earthworms
litter decomposition, 496

Erosion control
adaptability, 522

Erosion, 67, 521, 525, 1334
afforestation, 1867
deforestation, 1144
plantations, 67
roads, 109

Erythmelus empoascae
biological control, 3157

Establishment costs
teak forests, 3739

Establishment period, 1876

Ethnobotany
anti-diarrhea, 612
charcoal, 612

Etiolation
rooting, 1719

ETP
stump planting, 1297

Eucador
management, 3611

Eucalypts
mixed planting, 2475

Eucalyptus tereticornis
plantations, 2452

Eucoptacra ceylonica, 3117

Euctona machaeralis
Hyblaea puera, 2958

Eupatorium odoratum
gramoxone application, 2663
weeds, 2638, 2660

Eurema hecabe
defoliation, 2989

Europe
exports, 3900
industry, 3874

Eutectona grandis, 2904

Eutectona machaeralis, 2921, 2948, 2950, 2953, 2964, 2990, 2994, 3006, 3016, 3018, 3040, 3041, 3052, 3072, 3090, 3094, 3165, 3199, 3200, 3219
antifeedant property, 3156, 3211
Bangladesh, 2826
biological control, 2948, 3040, 3129, 3140, 3152
clonal resistance, 4455, 4490, 4491, 4506, 4508, 4509, 4510
feeding habits, 3054, 3055
hibernation, 3029
intensive management, 3116
Karnataka, 2950, 3024
Lantana camara var. *aculeata*, 3156
leaf moisture, 4506
leaves, 2994
light traps, 2871, 2964
management, 2826
microbial insecticide, 3165
migration, 3006
moulting, 3055
natural enemies, 3090
parasites, 3188
plant extracts, 3209, 3211
population dynamics, 2871, 2964, 3016
pupal-web formation, 3050
seasonal incidence, 3091
seedlings, 2800, 2801
spinning behaviour, 3050
sympiesis, 3090
volume increment, 3018

Evergreen forests, 1063, 1117
laterization, 253, 254
Myanmar, 1063
podzolization, 253

Evolution
gender, 700
gynoecium, 700

Exotic plantation
Burma, 2065

Exotic trials
Trinidad and Tobago, 2401

Exotics
Andamans, 1085
British empire, 4072
diseases, 2717
Pakistan, 1095
species introduction, 1094
Sudan, 1094

Explants
phenolic exudates, 618

Exports, 3901, 3965, 4613
asia, 3900
British India, 3943
Europe, 3900
India, 3877
Indonesia, 3933, 4613
Java, 3965
Myanmar, 3882, 4041
Netherlands, 3943
sawnwood, 3933
Siam, 3943
Thailand, 3901, 3938
timber quality, 1176, 4041

Extraction
drought, 2563

Extractives, 587, 628, 4179, 4344, 4531
allelopathy, 579
allergy, 4381
aluminium, 4370
anthraquinones, 4355, 4384
biochemistry, 4367, 4369
bond strength, 4321
caout chouc, 628, 4338
chemical properties, 590, 606, 4179, 4324, 4326, 4334, 4340, 4347, 4348, 4349, 4350, 4358, 4382, 4385
chromatographic analyses, 4358
copper, 4370
crushing strength, 4183
decay resistance, 4356, 4504, 4533, 4534
deoxylapachol, 4381
durability, 4337, 4343, 4356
flavonoids, 4348
fluorescence spectroscopic, 4349
gluing, 4326, 4336, 4496
heartwood, 4324, 4356
lignin contents, 4183
natural durability, 590
pesticide, 4347
Polyporus versicolor, 4533
Poria monticola, 4533
pulping catalysts, 606
quinones, 4363, 4364
rheological properties, 4341
seed germination, 579
shrinkage, 4344
specific gravity, 4183
termite resistance, 4358
toxicity, 587
utilisation, 4383
wood chemistry, 4354, 4338, 4341, 4351, 4355, 4383
wood destroying fungi, 4342

Factories
Thailand, 3956

Factory effluents
species trials, 1885

Fallow land, 385, 386

FAO, 879
bibliography, 19
genetic improvement, 769, 866
provenance trials, 756, 866, 879
Thailand, 769, 3619
Togo, 769

Farm forestry, 2441
economics, 2447
France, 2408
India, 300
irrigated plantations, 300
Laos, 2441, 3595
management strategy, 2344
plantations, 2408
Sri Lanka, 2344
Tamil Nadu, 2447, 300
Thailand, 2415

Farm lands, 319

Fast grown timber
durability, 4087
heartwood formation, 4086
juvenile wood, 3983, 4087
timber quality, 3980, 3981, 3982, 3983, 3989, 3998, 4003, 4037
wood properties, 4082, 4109
wood quality, 4083

Feeding habits
Eutectona machaeralis, 3054, 3055
Hyblaea puera, 2856
Spodoptera litura, 3057

Felling, 383, 1273, 2510, 3584, 3618
Burma, 1050, 1051, 2484
fire protected reserved forest, 2530
Java, 30, 2515, 2516, 2524, 2554, 3584
K. stump puller, 2554
machine, 2515
mechanization, 2516
Myanmar, 2551
regeneration, 1262, 1273, 1312, 2484, 3590
rotation, 3618
saws, 2521
taungya, 2484
Thailand, 383, 1273
tirfor, 2518, 2548
volume estimation, 3567
working plan, 2551
yield, 3567, 3584

Felling system
timber quality, 2539

Felling technique
Java, 2541

Fencing, 4658
agroforestry, 2461

Fernoxone
weed control, 2653

Fertigation
biomass, 2302, 2303
fertigation, 2304, 2304
fertilizers, 2274, 2276, 2305
growth, 2306
intensive management, 2302
irrigation, 2276, 2287, 2302, 2305
Karnataka, 2303, 2304, 2304, 2305
nutrient management, 2307
productivity, 2305
silvicultural treatments, 2274
timber production, 2274

Fertilisation
stand density, 2286

Fertilisers, 2241, 2270

Fertility evaluation
leaf position, 571

Fertility variation
fruiting, 636
gender, 636

Fertilization, 2266, 2313, 2323
clones, 822
growth, 2041
Nilambur plantations, 2266
nurseries, 2282
plantations, 2317
seed germination, 1415
seed orchards, 822
seedlings, 2264
thinning, 2041

Fertilizer trials, 196, 2284, 2312
timber production, 2274

Fertilizers, 243, 270, 2153, 2267, 2276, 2283, 2285, 2291, 2297, 2299, 2305, 2314, 2315, 2318, 2324, 2795
afforestation, 2277
alluvial soils, 2324
ammonium sulphate, 2285
azotobacter inoculation, 504
biomass production, 504
coir peat mulch, 2091
growth, 461, 2153, 2285
inorganic fertilisers, 2315
NPK fertilizers, 1666, 2290, 2320, 2322
nurseries, 504, 1670
nutrients, 2161, 2275, 2290, 2309
oil cakes, 2320
phosphorus, 2324
plantations, 270, 2161, 2291, 2297
potassium, 2295, 2300, 2309
review, 2295
seedlings, 504, 1670, 2314, 2315, 2319, 2795
sewage, 2277
soil nutrients, 461
soil properties, 243
vam fungi, 504

Fibre length, 674, 4094, 4128
branches, 4092
genetic variation, 4119
geographic variation, 4119

Fibreboard, 4705

Fibres, 4108, 4114

Field guide, 1199

Field manual
seed orchards, 876

Field performance, 2260, 2261
clones, 1692
micropropagated plantlets, 2261

Field tests
soft rot, 2708

Field trials
cell culture, 1743
crop rotation, 2009
micropropagated plantlets, 2261
plus trees, 2262
rooting, 1689
tissue cultured plants, 1689, 1743, 2262, 2263

Fiji, 3976

Filler
molding powder, 4694

Financial analysis
investments, 3726, 3811

Finishing
furniture, 4307, 4408

Finland
eczema, 583

Fire control, 2613

Fire damage
Thailand, 2596

Fire protected reserved forest
felling, 2530

Fire protection, 2243
Bori reserve, 2571
Burma, 2589, 2590, 2592, 2602, 2604
Ipomea carnea, 2593
Myanmar, 2597, 2598, 2599, 2610, 2611, 2621, 2623, 2624, 2625
North Kradenan Forest Division, 2622
teak forests, 2571, 2611, 2623, 2624

Fire resistance
mixed plantations, 2398
Xylia dolabriformis, 2398

Fires, 1363, 2594, 2615
Burma, 1318
Java, 2606
Kerala, 2594, 2595
protection, 2606
regeneration, 1242, 1278, 1318, 1363
reproduction, 1228, 2618
seed germination, 1228
soil erosion, 543
soil nutrients, 2595

soil properties, 2608, 2609, 2620
species trials, 1278
teak forests, 1228, 2607, 2617, 2620
Thailand, 543, 1278, 2608, 2609
Trinidad, 2612
wood damage, 2601

Flame treatment
oxidative activation, 4552

Flavonoids
chemical properties, 4348

Floating
Myanmar, 2535
transportation, 2537

Floor tiles
veneer, 4669

Flooring, 4631, 4716

Flora indica, 565

Flora
Gir forest, 1161
India, 559
Malaya peninsula, 564
Myanmar, 563
Tamil Nadu, 555, 557
Uttar Pradesh, 561

Floral anatomy, 700

Floral biology, 826, 827

Floral characteristics
genetic improvement, 980

Floristic composition
Andhra Pradesh, 133
synecology, 124

Flowered bamboo areas
regeneration, 1351, 1376

Flowering twigs
canker, 2779
Phomopsis, 2779

Flowering, 633, 637, 648, 930, 1131, 1495, 1553, 1596
Africa, 636
breeding, 741, 762, 805, 930
clonal seed orchard, 815
clones, 763
fertility variation, 636
fruiting, 636, 823, 830, 1495, 1596
gender, 636
genetic improvement, 762, 887
India, 1131
insects, 820
Kerala, 820
light, 648
Papua and New Guinea, 805
Philippines, 741
pollination, 741, 811, 820, 823
review, 1495
seed collection, 1495
seed orchards, 830, 908
seed production, 887
Siam, 637
teak forests, 1131
Thailand, 762, 930

Flowers
calli induction, 1696
insects, 2913
pollination, 2913
regeneration, 1696
Thailand, 657

Fluorescence spectroscopic study
extractives, 4349

Flushing
defoliation, 2930

Fluting
plantation grown teak, 3570

Fodder
cattle, 4734
leaf meal, 4721
leaves, 588, 589, 4746, 4750, 4754, 4760
nutritive value, 588, 589
sawdust, 4753

Foliage
chemistry, 582
fungi, 2723
morphology, 709
nutrients, 582
pipe model theory, 3430
sapwood, 3430, 3431

Foliar analysis
nutrient contents, 596

Foliar composition
nutrients, 614

Foliar constituents
leaves, 613

Foliar nutrients
genetic variation, 974
provenance variation, 918
seedlings, 918

Foliar
calcium, 210

Foliar protein
clonal resistance, 4484
Paliga machoeralis, 4484

Fomes lignosus
butt rot, 2758
root rot, 2758

Fomes lividus
decay, 2778

Food colourants, 4329

Food crops
intercropping, 2437

Food plants, 3069
Coptotermes formosanus, 2855
Prodenia litura, 2831

Foraging dynamics
pollination, 829

Forest Development Corporation
Madhya Pradesh, 3786
Maharashtra, 1659

Forest ecosystems
regeneration, 1346

Forest fires
Nigeria, 2616
soil properties, 2600

Forest floor
understorey, 146

Forest law
illegal cutting, 2550

Forest litter
decomposition, 420

Forest management
Kerala, 3832
Myanmar, 2349
taungya system, 2349

Forest mensuration
crown diameter, 3520

Forest pedology
afforestation, 348

Forest policy
afforestation, 1840
deforestation, 4776
India, 31, 1866
Madagascar, 2332
Myanmar, 41
plantations, 1920
Sri Lanka, 1920
Togo, 1840
Western Ghats, 4765

Forest preservation
Windward islands, 1861

Forest types
  Andhra Pradesh, 1098
  Central Provinces, 1089
  geology, 390
  India, 1072, 1073, 1074
  Kerala, 1074
  Madhya Pradesh, 1145
  Manipur, 1077
  Myanmar, 1072
  Nigeria, 57
  soil properties, 390
Forest village programme
  agroforestry, 2387
  Indonesia, 3954
  Java, 3954
  Thailand, 2387
Forestry
  fallow land, 385
  Pakistan, 1305
Forestry plantations
  Germany, 2256
Forestry research
  species trials, 27
Forking, 2680
Form quotient
  site quality, 4046
Formaldehyde
  chemical properties, 4309, 4310
Fossil leaf, 467
France, 29
  afforestation, 1828, 1831
  biotope, 128
  country reports, 29
  cultivation, 1831
  distribution, 1119
  ecological indicator, 128
  farm forestry, 2408
  Landolphia calabarica, 128
  Lecaniodiscus cupanioides, 128
  plantations, 1119, 2408
  seasoning, 3973
  seed treatment, 3973
  silviculture, 1119
  species diversity, 128
  thinning, 3973
  timber quality, 4293
  trade, 3875
  understorey, 128
  yield tables, 3333
French Africa, 1078
French West Africa Federation
  management, 2023
Fruit borer
  Dichocrocis punctiferalis, 2935
  Pagyda salvalis, 3073
Fruit damage
  birds, 1483
  mammals, 1483
Fruit development
  dry teak, 690
Fruit formation
  Pyrausta machaeralis, 2877
Fruit production, 823, 826, 830
  Kerala, 817
  pollination, 817, 823, 826
  seed orchards, 810, 830, 3216
  Thailand, 810, 826
Fruit size
  age, 1449
  seed germination, 1403, 1404, 1449, 1498
  sowing, 1574
Fruit variation
  clones, 900
Fruit yield
  insects, 831
Fruiting
  Africa, 636
  clones, 897
  fertility variation, 636
  gender, 636
  genetic variation, 897
  review, 1495
  seed orchards, 3037
Fruits, 1589
  emptiness, 706, 1436, 1542
  fungi, 2711
  grading, 1589
  moisture content, 645
  pre-sowing treatments, 1589
  seed germination, 1397, 1493, 1542, 1589, 1596
  seed quality, 1422
  seededness, 706
  weathering, 2711
Fuel oil
  durability, 4468
Fuelwood plantations
  Nigeria, 1857
Fuelwood
  calorific value, 4430
  Indonesia, 4448
  Madhya Pradesh, 3886
  Maharashtra, 3886
  Nigeria, 4726
  poles, 3485
  prices, 3886
  West Africa, 632
Fungal diseases, 2694
  Africa, 2726
  Armillaria mellea, 2726
  Armillaria root disease, 2718
  bacterial wilt, 2748, 2769
  Corticium Javanicum, 2691
  Corticium salmonicolor, 2691
  Indonesia, 2702
  Malaysia, 2746
  Nyasaland, 2718
  phytoalexins, 2688
  root rot, 2726
  seedlings, 2769
  Uncinula tectonae, 2714
Fungi, 2694
  Andhra Pradesh, 448
  Aspergillus, 454
  Bangladesh, 489
  cellulolytic microorganisms, 489
  Coniella, 454
  foliage, 2723
  fruits, 2711
  Indonesia, 2720
  Kerala, 454
  leaves, 448
  litter decomposition, 448, 454
  Madhya Pradesh, 2711
  nurseries, 2723
  Olivea tectonae, 2755
  penicillium, 454
  pollen, 2722
  saprophytic fungi, 2768
  seeds, 2722
  Tritirachium, 454
  weathering, 2711
Fungicides
  callus, 608
  collar rot, 2764, 2766
  Rhizoctonia solani, 2764
  seed germination, 1576
Fungus resistance, 4497
Furniture
  bending properties, 4747
  durability, 4429
  finishing, 4307, 4408
  juvenile wood, 4141

stains, 4718
wood finishing, 4400

Furrows
plantation grown teak, 3569, 3570

Fusarium
biological control, 3129
Hyblaea puera, 3129

Fusarium pallidoroseum
canker, 2713

Fusarium solani
die-back, 2697
pink disease, 2727
stem canker, 2697, 2727

Gal formation
Itonididae cecidmemyildal, 2890

Gall midges, 2968
Asphondylia tectonae, 2863
clones, 2863

Galls
leaf galls, 2910

Gamma radiation
growth, 3544

Gamma ray irradiation
seed germination, 1482

Gangetic alluvium
seed origin, 1018

Ganoderma lucidum
Karnataka, 2719

Gap planting, 2455

Gardens
canal zone experiment, 1872

Gender
evolution, 700
fertility variation, 636

Gene diversity
isozyme analysis, 937

Gene resources
genetic improvement, 932

Genecological zonation
genetic conservation, 1022

Genetic analysis
clones, 891
seed production, 871

Genetic conservation
genecological zonation, 1022
Thailand, 894, 1022

Genetic diversity
Random amplified polymorphic DNA markers, 869
Thailand, 869

Genetic improvement, 40, 854, 932, 953, 1025, 1225, 1339
Andhra Pradesh, 46, 954
biotechnology, 1759
Brazil, 1008
breeding, 738, 770, 775, 794, 795, 812, 846, 850, 863, 904, 912, 926, 966, 967, 977, 982, 1009
budding, 965
China, 40, 956
clonal seed orchard, 965, 4030
clonal variation, 1000, 1036
clones, 856, 889
Danish Thai Teak Improvement Centre, 1225
decorative properties, 794
Denmark, 947
DNA techniques, 1010
economics, 947, 1568
FAO, 769, 866
floral characteristics, 980
flowering, 887
grafting, 936, 965
growth performance, 915
growth, 794, 857, 889
hybridization, 978
hybrids, 846
India, 775, 795, 966, 977, 981, 982, 1003, 1023
Indonesia, 794, 799, 898, 909, 1009, 1010, 1021, 1044
insect control, 3105
IUFRO, 866
Karnataka, 855, 961
Kerala, 855, 914, 1038
Laos, 906
Mac huat teak plantations, 1030
Madhya Pradesh, 889, 953
Maharashtra, 890, 960, 1003
management, 854, 1568
Myanmar, 854, 906
New Guinea, 812
Nigeria, 987
North East India, 1020
nursery stock, 915
Papua and New Guinea, 812, 867, 877, 912, 1339
Perum perhutani, 1044
plantation establishment, 915
plantations, 872
planting sites, 856, 857
plus trees, 923, 954
pollination, 812, 996
productivity, 872
progeny trials, 46, 996
provenance research, 902
provenance trials, 791, 799, 866, 874, 1021, 4030
quality seeds, 945
quantitative theory, 952
RAPD variation, 982
reforestation, 784, 1590
regeneration, 966, 1339
reproductive biology, 980
reproductive traits, 1036
research, 40
review, 1046
seed collection, 1048
seed orchards, 863, 880, 936, 952, 953, 954, 970, 1000
seed origin, 880
seed production, 887, 977, 980, 1590
seedling growth, 1478
seeds, 1568
South Africa, 1008
stand characteristics, 970
superior phenotypes, 953
Tamil Nadu, 855, 880
Tanzania, 967, 996
teak forests, 769, 1225
Teak Improvement Centre, 1030, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845
Thai Danish Teak Improvement Centre, 903, 904
Thailand, 769, 770, 771, 784, 842, 847, 852, 853, 863, 902, 903, 938, 940, 942, 944, 945, 1025, 1042, 1225, 1590
timber quality, 794, 4011
Togo, 769
Uttar Pradesh, 1017
vegetative propagation, 885, 951
Venezuela, 791

Genetic inheritance
breeding, 762

Genetic parameters
progeny testing, 925
Genetic resources
breeding, 802
genetic improvement, 854, 1025
Maharashtra, 988
Myanmar, 854
Thailand, 1025
Genetic value
provenance trials, 861
Genetic variability
Karnataka, 984
Genetic variance, 783
Genetic variation
allozyme diversity, 950
Arunachal Pradesh, 1019
China, 955
clones, 897, 1019
Cote d'ivoire, 779, 780
fibre length, 4119
foliar nutrients, 974
fruiting, 897
geographic variation, 4119
germplasm, 1019
heritability, 1016
India, 780, 781, 950, 955
Indonesia, 779, 780, 781
isozyme variation, 779
Java, 779
Karnataka, 744, 779, 897
Kerala, 744, 860
Laos, 744, 781, 950
Maharashtra, 1015
mating system, 780
multivariate study, 781
Nicaragua, 950
Nigeria, 739, 955
Orissa, 800, 1015, 1016
plus trees, 955
progeny testing, 800, 1015, 1016
provenance trials, 955
seed production, 974
selection criterion, 860
Tamil Nadu, 950
Tanzania, 779, 780, 950
Thailand, 779, 780, 781, 950, 955
timber quality, 860
Uttar Pradesh, 744
West Bengal, 744
Genetics
breeding, 774, 777, 790, 797, 807
heritability, 807
India, 776, 797
Nigeria, 807
seed origin, 864
Genomes
DNA transfer, 983
Genotypes
rooting, 1686
Geographic variation
fibre length, 4119
Geographical Information System
resource assessment, 3486
Uttar Pradesh, 3486
Geography
Madhya Pradesh, 96
site factors, 96
Geology
site factors, 73
soil properties, 281, 390
Germany
chemical components, 598
cultivation, 1851
forestry plantations, 2256
Liberia, 1909
medicinal properties, 598
reforestation, 1909
roots, 598
tanga region, 2256
tanganyika, 1851
wood extractives, 4323
wood properties, 4031
Germinability
seeds, 1559
Spermoplane microflora, 1559
Germination inhibition
fruits, 1397
leaf extract, 594
Germination medium
seed germination, 1555
Germination (*see also* seed germination)
clear felling, 2514
pre-sowing treatments, 1589
seedling growth, 1474
sowing, 1474
water extracts, 609
Germplasm
Arunachal Pradesh, 1019
clones, 1019
Ghana, 935, 949, 1100, 1550, 2820
Danida Forest Seed Centre, 949
field guide, 1199
international effort, 949
juvenile wood, 4053
marketing, 44
nurseries, 1654
plantation establishment, 106
plantation grown teak, 4053
plantations, 175, 176
planting, 1100
preservative treatment, 4539
processing, 44
production costs, 1654
productivity, 3449
propagation, 44
provenance trials, 935, 949
seed age, 1529
seed germination, 1529
seed processing, 1550
seed treatment, 1529
seedlings, 1654
site factors, 106
soil properties, 106, 175, 176, 343
species trials, 1814
utilisation, 44
volume tables, 3519
Giant timber
Assam, 3423
Burma, 2366
Kerala, 550, 3354, 3369
Maharashtra, 3342
Malabar, 3369
measurements, 3546
Myanmar, 3483, 3484, 3492
Tamil Nadu, 3564
Tekkadi, 3357
Travancore, 550
Gibberellic acid
growth, 1669, 1700, 1702
plantation trials, 1781
rooting, 1694
seed germination, 1588
seedling growth, 1588, 1648, 1651, 1663, 1664, 1669, 1700, 1702, 1747
Gibberellin
seed germination, 1501
Gir forest
litter production, 442

soil chemistry, 442
Girdling
Burma, 2495, 4012
green felled trees, 4296
harvesting, 2499
Java, 2500
Myanmar, 2495
physical properties, 4296
seasoning, 4535, 4536
timber quality, 2499
wood properties, 2498
Girth measurement, 3304
Glenea galathea, 2834
Glenea Indiana, 2834
Gliders
air craft, 4215
Gliocladium
amylases, 449
decomposing fungi, 449
Global warming
carbon dioxide absorbtion, 81
carbon dioxide, 179
Glomus caledonium
biofertilizers, 2268
vesicular arbuscular mycorrhizae, 2268
Glomus fasciculata
Andhra Pradesh, 483
vesicular arbuscular mycorrhizae, 483
Glomus macrocarpus, 520
growth enhancement, 519
seed germination, 1588
Glomus mosseae
Andhra Pradesh, 483
vesicular arbuscular mycorrhizae, 483
Gluability
extractives, 4336
Gluing, 4222
adhesives, 4402, 4417
dowels, 4333
extractives, 4326, 4496
joints, 4289
polyvinyl acetate, 4417
wood properties, 4289
Gold coast
silviculture, 1201
Gold content
neutron activation analysis, 4346
Gold
wood chemistry, 4303
Government teak plantations
India, 3772
investments, 3772
Netherlands, 3772
Grading
Burma, 4592
felling, 3584
fruits, 1589
Indonesia, 4571
Japan, 4580
Java, 3584
pre-sowing treatments, 1589
sawnwood, 4612
scaling, 4604
shrinkage, 4608
South East Asia, 4601, 4604
standardization, 4601
superior phenotypes, 953
Thailand, 4572
utilisation, 4603
yield, 3584
Grading rules
Asia Pacific, 4588
Indian standard, 4596
Indonesia, 4576, 4598
Myanmar, 4610
Thailand, 4606
United Kingdom, 4584
veneer, 4606, 4610
Grading school
Singapore, 4599
Grafting, 1704, 1739
branch cuttings, 1749
breeding, 806, 1726
bud grafting, 1777
budding, 965, 1727, 1728, 1729, 1763, 1776, 1794
clonal propagation, 1794
clonal seed orchard, 965
clones, 1785
coppice, 1802
genetic improvement, 936, 965
humidity, 1794
macropropagation, 1763
mortality, 1784
plus trees, 995, 1621
root grafts, 1693
rooting, 1763, 1802
shoot cuttings, 1802
vegetative propagation, 995, 1621, 1693, 1726, 1729, 1749, 1802
Grain contraction
seasoning, 4553
Gramoxone application
Eupatorium odoratum, 2663
Grass
burning, 1988
growth, 2367
seedlings, 2367
understorey, 112
Grasslands
species trials, 1895
Graveyard test
wood durability, 4453
Grazing, 2680
teak forests, 2683, 2686
Green felled trees
girdling, 4296
physical properties, 4296
Green manures
soil nutrients, 147
teak forests, 2370
Greenhouse gas
afforestation, 76
comap model, 76
Greening
degraded forests, 1878
Grobogan forest section
regeneration, 1359
Ground flora, 149
productivity, 119
species diversity, 119
succession, 140
Groundnut
agroforestry systems, 2418
mixed cropping, 2418
Group planting system
plantation establishment, 1908
Growing area
classification, 4614
Growing media
seed germination, 1511
seedling growth, 1661
Growth analysis
sono method, 3515
Growth behaviour
intensive management, 3841

Growth dynamics, 3508

Growth enhancement
- *Aspergillus niger*, 519
- *Glomus macrocarpus*, 519

Growth evaluation
- China, 1047
- provenance trials, 1047

Growth factors
- durability, 4471

Growth hormones
- rooting, 1764
- seed germination, 1576

Growth irregularity, 3269

Growth measurement, 3296

Growth modelling
- basal area, 3580
- crown diameter, 3422
- diameter at breast height, 3422
- height-diameter relationship, 3581
- plantations, 3372
- silviculture, 3463
- site quality, 3549
- yield, 3580

Growth performance
- biomass production, 3328
- nursery stock, 915
- plantation establishment, 915
- stumps, 1799
- Thailand, 1799, 3311
- yield, 3290

Growth periodicity
- timber quality, 728
- wood formation, 3472

Growth prediction
- Vietnam, 3446

Growth rate, 3267, 3277, 3314, 3339, 3341, 3359, 3387, 3421, 3424, 3428, 3501, 3554
- basic density, 3478
- cambium age, 4124
- clones, 3478
- density, 4124
- durability, 4472
- economics, 3623
- growth rings, 3398, 3453, 4134
- heartwood content, 3478
- irrigated plantations, 2293
- plantation grown teak, 4256
- released strain, 3554
- seedlings, 1634
- site quality, 3609
- species trials, 1141
- stump analysis, 3288, 3516
- stump size, 1604
- teak forests, 3609
- thinning, 2116
- timber quality, 3322, 4213
- wood properties, 4211, 4214, 4256
- wood quality, 3481
- yield tables, 3314

Growth regulators
- dry matter production, 1748
- indole acetic acid, 1748
- seedlings, 1748, 1782, 2292

Growth rings, 678
- anatomy, 689
- cambial activity, 673
- climate, 718, 729, 4099
- dendrochronology, 718, 726, 729, 731, 4130
- dendroclimatology, 688, 722, 737
- fibre length, 674
- growth rate, 3398, 3453, 4134
- heartwood proportion, 4081
- juvenile wood, 673
- rainfall, 717
- water conditions, 2308
- wood anatomy, 673, 731, 4078, 4098, 4123
- wood density, 4081
- wood formation, 2308

Growth statistics, 3343

Growth stimulators
- leaf extract, 607
- seedling growth, 607

Growth stress
- wood properties, 2581

Growth substances
- seedling growth, 1789

Growth, 637, 1372, 1589, 1732, 2239, 2367, 2452, 3562
- Africa, 719
- age, 3282
- agroforestry, 2356, 2357
- Amazon, 3291
- America, 1995
- ammonium sulphate, 2285
- Andhra Pradesh, 653, 1004, 1656
- annual increment, 3556
- architectural analysis, 2357
- architecture, 2356
- b-horizon, 323
- Bangladesh, 2381, 2824, 3282
- Bihar, 3810
- biofertilizers, 2321
- biomass production, 3450
- Brazil, 3291, 3414
- breeding, 794
- bud grafting, 1777
- burning, 1987
- China, 1047
- climatic factors, 4143
- clonal origin, 975
- clones, 889, 927, 1004
- coppice forest, 3412
- Costa Rica, 59, 100
- decorative properties, 794
- defoliation, 2824, 2840, 2841, 2853
- drip irrigation, 2296
- dry matter production, 3578
- Dutch East Indies, 3350
- economic returns, 3707
- economics, 975, 3677
- edaphic conditions, 397
- environmental factors, 59
- fertigation, 2306
- fertilization, 2041
- fertilizers, 461, 2153, 2285
- fires, 1363, 2615
- flowering, 637
- fruits, 1589
- gamma radiation, 3544
- genetic improvement, 794, 857, 889
- germination, 1589
- gibberellic acid, 1669, 1700, 1702
- grading, 1589
- grafting, 1777
- grass, 2367
- growth evaluation, 1047
- heartwood, 3555
- height growth, 720
- home gardens, 2356
- Honduras, 397
- hormones, 2110
- *Hyblaea puera*, 2824
- increment borer, 3556
- India, 1777
- Indonesia, 542, 794, 964, 3365
- interplanting, 2478

irregular growth, 3362
irrigated plantations, 3707
irrigated stands, 3435, 3436
Java, 975
Kerala, 218, 2356, 2357, 3487
kumri crops, 2333
laterite soil, 304
leguminous creepers, 2331
Liberia, 3582
Madhya Pradesh, 889, 1372, 1700, 2202, 2296
Mae huad teak plantation, 336, 337
Malaysia, 1227, 2173
management, 2239
Mexico, 1995
mistletoe, 2631
mixed plantations, 2381
moisture conservation, 2321
Myanmar, 1332, 3276, 3419, 3468, 3535, 3545
natural regeneration, 1301, 1332, 1371
Nigeria, 53, 3543
Nilambur, 3505, 3526
nutrient requirements, 3450
nutrient uptake, 1614, 3582
Perlis, 304
phenology, 3526
phenotypes, 653
Philippines, 1934
photosynthesis, 653
physiology, 719
plantation establishment, 2239
plantation raising, 1934
plantations, 1227, 1995, 2110, 2452
planting density, 3436
planting methods, 2153
planting sites, 857
podzolization, 3291
pre-sowing treatments, 1589
productivity, 3487
provenance trials, 848, 964, 1047, 1148
pure teak plantation, 1971
rainfall, 53, 259, 735
regeneration, 1363, 1372
research, 2239
root trainers, 1656
rooted cuttings, 1797
rooted stumps, 2193
rooting, 2110
rootless stumps, 2193
rotation, 3487
saplings, 2853
seed emptiness, 1517
seed germination, 1460, 1517, 2239
seed orchards, 927
seed origin, 975
seed treatment, 2239
seedlings, 542, 1363, 1614, 1656, 1700, 1797, 2367, 3578
shelterbelt, 2452
shoot cuttings, 1797
Siam, 637
site factors, 100, 111, 3582
site index, 100, 111
site quality, 324
site selection, 3535
slash burning, 218
sodic soils, 330
soil aggregate, 324
soil depth, 336, 337
soil fertility, 3392
soil nutrients, 461
soil properties, 190, 218, 223, 259, 323, 397, 2202, 3300, 3528, 3579
soil types, 2381
spacing, 2224, 3440
Sri Lanka, 3560
stump planting, 1656, 2193
stump size, 2246
stump storage, 1650
stumpage value, 3365
stumps, 1656, 2285
successive rotations, 190
survival, 1650, 2246, 3495
Taiwan, 111, 3439
Tamil Nadu, 259
Tanzania, 2044, 2224
taungya, 218, 2362
Thailand, 223, 323, 324, 336, 337, 735, 848, 1650, 1669, 1702, 2192, 2193, 2239, 2246, 2478, 3299, 3321, 3382, 3464, 3495, 3498, 3513, 3528, 3536, 3544, 3555, 3556, 3579
thinning, 2041, 2192, 3542
thinning intensity, 2173
timber quality, 794
topography, 3528
underplanting, 2334
Uttar Pradesh, 330
Virgin islands, 1148
volume tables, 3545
water conservation, 542
water stress, 653
weed control, 2044
weed growth, 218
West Indies, 1995
wood properties, 2631, 4143
wyanad, 3505
yield prediction, 3351
yield tables, 3505
yield, 848, 3435, 3436, 3455

Guadalcanal grasslands
afforestation, 1839

Guidelines
nursery practices, 1623

Gujarat, 443, 3751, 4125
afforestation, 3681
chemical properties, 314
cost benefit analysis, 3681
cultivation, 1918
dry deciduous forests, 1153
Gir forest, 442
ground flora, 149
investments, 3751
Jivrajbhal patel agroforestry, 1918
phytosociology, 1162, 1163
plantation schemes, 3751
plantation techniques, 1918
productivity, 3458
rainfall, 538
seasonal behaviour, 734
seasonal distribution, 615
seasonal variation, 441, 733
soil chemistry, 314, 441, 442
soil properties, 314
species association, 1061
species diversity, 1158
synecology, 1150, 1157
teak forests, 71
throughfall, 538
vegetation ecology, 1153

Gynoecium
evolution, 700
gender, 700

Habitat use
elephants, 2682
wildlife, 2679

Habitats
Indonesia, 151
monkey, 151

Halictus
pollinators, 821
Haliyal teak pole forests
Karnataka, 3827
working plan, 3827
Hand cart
transportation, 2508
Handsaw technique
harvesting, 2540
Hapalia machaeralis, 2818, 2829, 2857
biological control, 3137, 3138
defoliation, 2813, 2854
Hyblaea puera, 2813, 2830, 2833, 2854, 2960, 2981, 2983, 3080, 3124, 3128, 3137, 3138, 3145
parasites, 3137, 3138, 3145
Hardboards
Thailand, 4693
Hardening
Madhya Pradesh, 1786
micropropagated shoots, 1786
rooting, 1786
Hardness
mineral constituents, 4308
Hardwood logs
railways, 4574
Hardwood seedlings, 2774
Hare attack
plantations, 2685
Harvesting, 375, 2487
Burma, 2485, 2509, 2513, 2527
clear cutting, 2543
cutting force, 2531
economics, 2547, 2556
elephants, 2555
girdling, 2499
handsaw technique, 2540
Indonesia, 2491, 2493, 2497, 2542
Java, 2489, 2491, 2507
logging, 2491, 2523
mechanization, 2519, 2527
Myanmar, 2555
poles, 2519
rotary cutters, 2531
stumps, 375
Sudan, 2487
teak forests, 2490, 2542
Thailand, 375, 2490, 2547
Thenmala forest division, 2538
timber quality, 2499
wastage, 2534
Haryana, 4282
nursery diseases, 2747
Heart rot
Indonesia, 2690
Madhya Pradesh, 2724
Heartwood content
basic density, 3478
Heartwood development, 1367
Heartwood formation, 4113
fast grown timber, 4086
Heartwood proportion
growth rings, 4081
plantation grown teak, 4112
wood density, 4081
wood quality, 4120
Heartwood, 4103
calcium, 692
chemical properties, 4324
decay resistance, 4356
growth, 3555
histochemistry, 4314
silica, 692
stony deposit, 2577
strength properties, 4244
thickness, 3334
Virgin islands, 692
Heat treatment
bending properties, 4566
seed germination, 1491
Heating
acid treatment, 1552
nutrient release, 288
seed germination, 1544, 1552
Hedge crop
Indonesia, 2566
Height
age, 103, 670, 3475
crown diameter, 3363, 3473
crown, 3476
dbh, 3363, 3473, 3476
diameter, 670, 3476
site quality, 103, 3475
soil depth, 373
Height diameter curves
volume estimation, 3374
Height growth, 720
Height measurements
multimeter, 3371
plantation grown teak, 3371
Height-diameter relationship
growth modelling, 3581
thinning, 3581
Helicobasidium compactum
root rot, 2728, 2729, 2730
Helicoverpa armigera
Hyblaea puera, 3181
nuclear polyhedrosis virus, 3181
Henna dye, 4756
Herbicides
chemical control, 2207
coppicing, 2207
soil microorganisms, 471
Herbivory
leaf flushing phenology, 3003
Heritability
breeding, 807
clones, 891, 4197
genetic analysis, 891
genetic variance, 783
genetic variation, 1016
plus trees, 801
progeny testing, 1016
wood density, 4197
wood properties, 789
Hestiasula brunneriana, 2798
Heterocephalum aurantiacum
amylases, 449
decomposing fungi, 449
Heterotermes tenuis
termite damage, 3227
Heterotrophic nitrification
soil chemistry, 502
Hibernation
Eutectona machaeralis, 3029
Himachal pradesh
seed stands, 798
Himalaya
regeneration, 52
soil compaction, 328
Hindoos
imports, 1058
Java, 1058, 1066
Histochemistry, 4314
History, 1067, 2166, 3830
Cuba, 101
India, 2137, 3835, 3866
Indonesia, 1067, 3789, 3846

Konni teak plantations, 2166
Myanmar, 3830
Nilambur plantations, 2137
teak forests, 101

Holotrichia insularis
chemical control, 3224
insecticides, 3210

Holotrichia serrata
chemical control, 3198
Eutectona machaeralis, 2990
Hyblaea puera, 2990
insecticides, 3225

Home gardens
Kerala, 2356, 3399

Honavar range
regeneration, 1279, 2058

Honduras, 4301
afforestation, 1838
edaphic conditions, 397
Madelena project, 1218
silviculture, 1218

Hormones
fruit production, 3216
growth, 2110
rooting, 1681, 2110

Host parasite
Dendrophthoe falcata, 2655
water relations, 2655

Host plants
Hyblaea puera, 2823, 3051

Host record
Hyblaea puera, 2805

Host specificity
biological control, 2995
Leptobyrsa decora, 2995

Host-parasite relationship
chemical control, 2647
mistletoe, 2647

Housing
Indonesia, 4403
preservative treatment, 4540
Venezuela, 4540, 4624

Huay tak
soil properties, 236

Humic acid
seedling growth, 2281

Humidity
clonal propagation, 1794
plantations, 66
seed longevity, 1398
seeds, 1586

Hyblaea puera, 2813, 2826, 2830, 2833, 2844, 2846, 2854, 2867, 2871, 2889, 2916, 2923, 2933, 2948, 2953, 2960, 2964, 2981, 2983, 2990, 2994, 3006, 3016, 3018, 3040, 3041, 3077, 3080, 3090, 3094, 3116, 3124, 3128, 3129, 3131, 3132, 3137, 3138, 3145, 3164, 3166, 3219
aerial spraying, 3222
Amsacta albistriga, 3181
Andhra Pradesh, 3032, 3033
Anthia sexguttata, 3166
Aspergillus flavus, 3149
azadirachtin, 3203
Bacillus thuringiensis, 2903, 3093, 3161, 3168, 3221
bacterial pathogens, 3093
Baculovirus, 3190
baculovirus control, 3173
Bangladesh, 2823, 2824, 2825, 2826
Beauveria bassiana, 3040, 3041, 3129, 3183
biochemical diversity, 3004
biocontrol, 3132
biological control, 2948, 3040, 3129, 3131, 3137, 3138, 3149, 3150, 3158, 3168, 3170, 3171, 3172, 3189, 3190, 3193
bird predators, 3197
Brachymeria euploeae, 3195
Brachymeria lasus, 3090
Brazil, 3035
Carcelia kockiana, 3195
Chaenus rayotus, 3143
chemicals, 3222
clonal resistance, 4492, 4493
control, 2881, 2903, 3171
Corcyra cephalonica, 3030
defoliation, 2813, 2824, 2854, 3015, 3017, 3019, 3160
defoliators, 3008, 3016, 3191
digestion, 2994
Echthromorpha notularia, 3195
elevation, 2844
Enterobacter aerogenes, 3090, 3093
entomopathogens, 3150, 3183
epicentres, 3019, 3191
feeding habits, 2856
Fusarium, 3129
growth, 2824
Helicoverpa armigera, 3181
host plants, 2823, 3051
host record, 2805
India, 2833, 2906
infestation, 2962
insect parasitoids, 3170
insect pests, 2867, 2916, 2923, 3035, 3116, 3168, 3173
insect rearing, 2978, 3030
insecticides, 3205, 3217, 3221
integrated pest management, 3164
intensive management, 3116
irrigated plantations, 2963
Karnataka, 2830
Kerala, 2998, 3008, 3019
larvae, 2869
leaves, 2994
light traps, 2844, 2871, 2964
Lygropia quaternalis, 3137
Madhya Pradesh, 2844, 2906
Malaysia, 2867
management, 2826
management strategy, 3013
Metarhizium anisopliae, 3150, 3183
microbial pathogens, 3131, 3132
migration, 2843, 3006, 3017, 3112
monsoon, 2843
morphology, 2869
Myanmar, 2846
natural enemies, 3090, 3167, 3179
neem extract, 3203
Netherlands, 2933
New Guinea, 3104
nuclear polyhedrosis virus, 3092, 3130, 3169, 3172, 3181, 3182
Palexorista solennis, 3090, 3193
Papua and New Guinea, 2881
parasites, 3137, 3138, 3145, 3187, 3194, 3195
parasitism, 3158
parasitoids, 3167, 3189, 3192, 3193
Pavonia odorata, 3160
Pavonia zeylanica, 3160
pest resistance, 4494

population dynamics, 2825, 2871, 2964, 2999, 3016, 3059
predators, 3159, 3166, 3167
Pseudomonas aeruginosa, 3093
rainfall, 2962
reproductive behaviour, 3096
review, 3053
seasonal distribution, 3032, 3033
seasonal incidence, 3015
seedlings, 2854
Serratia marcescens, 3093
Spathodea campanulata, 2805
Spodoptera litura, 3181
Sturmia inconspicuella, 3143
Sympiesis, 3090
Sympiesis hyblaeae, 3192, 3193, 3194
Thailand, 2903, 2958
tree height, 3031
Trichogramma, 3095
Trichogramma chilonis, 3030, 3031, 3178
understorey, 3160
Vitex altissima, 2998
volume increment, 3018
Xyleborus destruens, 2933

Hybridization
genetic improvement, 978

Hybrids
genetic improvement, 846

Hydraulic conductivity
soil properties, 527

Hydrochloric acid
seed germination, 1481, 1497

Hydrogen peroxide
seed germination, 1510

Hydrogenolytic degradation
pulps, 4318

Hydrology, 168
erosion, 525
leaf litter, 65
litter decomposition, 444
plantations, 526
rainfall interception, 65, 526
rainfall, 61, 444
soil chemistry, 548
stemflow, 545, 546, 547
tropical dry deciduous forest, 547
water use, 537
watershed management, 541

Hydroxylapachol, 4331

Hypothenemus pusillus
shoot borer, 2873

Hyptis suaviolens
seed germination, 1577

Hysteresis properties
wood properties, 4184

IBA
clonal propagation, 1720
vegetative propagation, 1676

Ibadan fuel plantations
investments, 3813

Icerya aegyptica, 3086

Identification
defoliation, 2859
insect pests, 3097
landsat MSS data, 3260
wood anatomy, 4095

Identification key
wood anatomy, 4100, 4105, 4115

Illegal cutting
Thailand, 2526, 2550, 2552

Imperata, 125

Imperata cylindrica
teak forests, 2637
weed control, 2070, 2084

Imports
Hindoos, 1058
Ireland, 3883
Java, 1058
New Guinea, 3883
timber trade, 3885

Improvement planting
planting programme, 1945

In vitro culture
propagation, 1752
tissue culture, 1793

In vitro digestibility
litter decomposition, 410

In vitro propagation
seed germination, 1778

Incense
sawdust, 4755

Increment borer
growth, 3556

Increment, 3294, 3465
basal area, 3441
clay content, 364
prodan's method, 3338

spacing, 2030
stand tables, 3338
thinning, 2010
yield prediction, 3489
yield tables, 3563
yield, 3524

India, 2, 3, 29, 248, 780, 781, 859, 935, 955, 968, 992, 1072, 1140, 1182, 1185, 1239, 1550, 1617, 1973, 2108, 2130, 3772, 3881
acid tolerance, 992
afforestation, 1951
air seasoning, 4543
allelopathy, 601
allozyme diversity, 950
aluminium tolerance, 992
Andhra Pradesh, 737, 1005
artificial regeneration, 1235
Bihar, 401
breeding, 758, 773, 775, 795, 797, 966, 982
breeding strategy, 977
bud grafting, 1777
calcium, 402
calorific value, 4444
carbon dioxide evolution, 463
carbon, 361
certification, 4605
chemical properties, 314
clay content, 364
clones, 992
conservation, 982
control, 2842
Costus speciosus, 601
country reports, 29, 35, 49, 1458
defoliation, 2858
dendroclimatology, 737
diseases, 2773
distribution, 15
ecology, 56, 1084, 1090, 1122, 1132, 2842
economics, 12, 3850
Eupatorium odoratum, 2660
exports, 3877
farm forestry, 300
fertilizers, 270
flora, 559
flowering, 1131
forest policy, 31, 1866
forest types, 1072, 1073, 1074

genetic improvement, 775, 795, 966, 977, 981, 982, 1003, 1023
genetic variation, 780, 781, 950, 955
genetics, 776, 797
Government teak plantations, 3772
grafting, 1777
growth, 1777
growth rings, 737
Gujarat, 314
Hapalia machaeralis, 2818, 2833
history, 2137, 3835, 3866
Hyblaea puera, 2833, 2906
increment, 364
insect pests, 12, 2842, 2848
international programmes, 1005
inventory, 3256
investments, 3607, 3624, 3682, 3717, 3762, 3770, 3772
irrigated plantations, 300
Karnataka, 285
Kerala, 279, 347, 453, 1074, 2660, 3605
labelling, 4605
laterite soil, 371
leaves, 460
litter decomposition, 453, 460, 462, 463
Madhya Pradesh, 56, 320, 354, 355, 387, 389, 402, 403, 2906
Maharashtra, 1003, 1638
management, 2, 49, 1185, 2108, 2220, 3605, 3622, 3645, 3689, 3839, 3850, 3866
mating system, 780
microbial activities, 463
minerology, 387
moisture absorption, 4673
mortality, 320
multivariate study, 781
Myllocerus viridanus, 2797
natural regeneration, 1239
Nilambur plantations, 2137
nutrient deficiency, 285
nutrients, 241, 248, 286, 303, 361, 370, 371, 376, 401, 403
organic matter, 286
Paralongidorus sali, 515
particle boards, 4673
physiology, 1132
plantations, 270, 352, 1134, 2137, 2636, 2773, 3605
plantation forestry, 2130
planting, 1638
planting stock, 1638
plus trees, 955, 1024
plywood, 4668
prices, 3881
production, 3820
productivity, 1131, 3605
progeny testing, 1024
provenance trials, 935, 955, 968, 1005, 1024, 1488
rainfall, 252
RAPD variation, 982
regeneration, 966, 1247
report, 4770
research, 1212, 1215
review, 1130, 1442
root trainers, 1638
Sahyadrassus malabaricus, 2833
seed germination, 1131
seed management, 1458
seed orchards, 1458
seed origin, 859, 2220
seed processing, 1550
seed production, 977
seed research, 1488
seed storage, 1442
seed treatment, 1488
seed weight, 1464
seedlings, 285
seminar proceedings, 2
silviculture, 2, 12, 15, 49, 1171, 1182, 1185, 1217, 1973, 2108, 2220
site factors, 56
site preparation, 347
slash burning, 347
soil chemistry, 241, 252, 271, 303, 314, 320, 322, 340, 341, 354, 355, 361, 369, 370, 389, 402
soil fertility, 270, 352, 391
soil organic matter, 271
soil properties, 248, 279, 300, 314, 322, 340, 347, 352, 355, 359, 364, 369, 387, 401, 403, 2220
species diversity, 1134
stump planting, 1235, 1617, 1890
survey, 3255
swelling properties, 4673
Tamil Nadu, 252, 270, 300, 322, 359, 950, 1024, 1235, 1890, 2636
teak forests, 1130, 1131, 1132, 1134, 1137
teak improvement, 1024
teak plantation, 391
Teak sub commission, 4770
thinning, 2123
tissue culture, 1024
trade, 3868, 3869, 3923, 3934
transmission poles, 4643
utilisation, 4000, 4650, 4651, 4654, 4655, 4656
Uttar Pradesh, 271, 361, 460, 462, 515
Uttaranchal, 286
Varanasi, 463
vegetation types, 322, 1093
vegetation, 252, 359
volume tables, 3317, 3344
weed growth, 2636
weeds, 2660
West Bengal, 241, 303, 341, 364, 369, 370, 371, 601
wildlife, 352
wood properties, 12, 4020, 4045
working properties, 4414
Xyleutes ceramica, 2816, 2833

Indian standard
grading rules, 4596

Indole acetic acid
dry matter production, 1748

Indomecus bombayensis, 2896

Indonesia, 3, 29, 90, 539, 726, 779, 780, 781, 799, 968, 990, 1140, 1617, 1699, 1836, 1940, 2108, 2132, 2339, 2445, 2488, 2491, 2516, 2525, 2947, 3922, 3954
afforestation, 1849, 1871, 1903, 1904, 1949
age, 123, 3510
agroforestry, 2433, 2436, 2456, 2458
anti-diarrhea, 612
ash, 591
basal area, 3512, 3566
bibliography, 3010
biomass estimation, 3474
birds, 160

breeding, 764, 766, 794, 1009, 1997
carbon dioxide absorbtion, 81
carbonization, 4320
cash crops, 2436
cement board, 4689
charcoal, 612
chemical content, 4312
classification, 4613
clonal seed orchard, 990, 991
clones, 822
conservation, 3860
Coptotermes curvignathus, 2947
costing system, 2525
country reports, 29, 50
crown, 3566
Cryptotermes, 2943
cultivation, 1823, 1824, 1836, 1855, 1940, 2445, 2458, 3586
culture technique, 1680
database, 3661
decorative properties, 794
defoliation, 2939
degraded soil, 1949
dendrochronology, 726
dendroclimatology, 688, 723
diameter distributions, 3309
diameter, 3510
Diospyros celebica, 2339
diseases, 3010
distribution, 1067
DNA techniques, 1010
dry monsoon areas, 1849
Duomitus ceramicus, 2924
economics, 3616
embryogenesis, 822
erosion, 109
establishment costs, 3739
ethnobotany, 612
Eupatorium odoratum, 2638
exports, 3933, 4613
felling, 2510, 2516, 3618
felling system, 2539
fertilization, 822
food crops, 2437
forest village system, 3954
fuelwood, 4448
fungal diseases, 2702
fungi, 2720
genetic improvement, 794, 799, 898, 909, 1009, 1010, 1021, 1044
genetic variation, 779, 780, 781
global warming, 81
grading, 4571
grading rules, 4576, 4598
graveyard test, 4453
growth, 542, 794, 964, 3365
growth measurement, 3296
growth rate, 3314, 3554
growth rings, 688, 726
habitats, 151
hand cart, 2508
harvesting, 2491, 2493, 2497, 2542
heart rot, 2690
hedge crop, 2566
history, 1067, 3789, 3846
housing, 4403
in vitro culture, 1793
increment, 3294, 3524
industry, 3951, 3952, 3961, 3963
insect pests, 2992, 3010, 3101
intensive management, 3330
intercropping, 2045, 2271, 2340, 2437, 2458
International teak commission, 4767
inventory, 3247
investments, 3626, 3809
isozyme variation, 779
Karnataka, 779
labour, 3845
leaves, 591
loading, 3952
logging, 2491, 2510, 2517, 2525, 2546, 3643, 3954
longicorn borer, 2937
Malabar teak, 1113
man made forests, 1997
management, 50, 2108, 3612, 3614, 3628, 3656, 3657, 3658, 3661, 3693, 3694, 3711, 3789, 3797, 3798, 3814, 3842, 3845, 3846, 3858, 3859, 3860, 3861, 3864
mapping, 3266
marketing, 3897, 3928, 3951
mating system, 780
mechanization, 2516
medicinal plants, 130, 131, 141, 4744
medicinal properties, 612
mensuration, 3524
mixed cropping, 2339
mixed plantations, 2445
moisture content, 4176
monkey, 151
Monohammus rusticator, 2937
multivariate study, 781
mycorrhiza, 479
natural regeneration, 1251
Neotermes tectonae, 2942
NPK fertilizers, 2271
nutrients, 591
Perum perhutani, 1044, 4778
plantation establishment, 1846, 1871, 1941
plantation trials, 1113, 2339
plantations, 2026, 2803
planting, 2148
planting stock, 1699
pollination, 822
production, 3818
production economics, 4652
productivity, 3330, 3331, 3474, 3509
provenance trials, 799, 964, 968, 1021
Pyrausta machaeralis, 3023
radial growth, 661
railways, 109, 2522, 4652
reforestation, 1238
regeneration, 1256, 1940
released strain, 3554
reproductive biology, 990
reproductive phenology, 991
review, 3010
roads, 109
root fungus, 2725
rotation, 2020, 2057, 2132, 2255, 3618
sawmilling, 3961
sawnwood, 3933
seed collection, 1001
seed orchards, 822, 1001
seed origin, 1941
seed production, 990
seedlings, 542
shade, 62
silvicultural management, 3851
silviculture, 1195, 2022, 2108, 4767
site classification, 90
site index, 3308, 3358
site quality, 3618

skidding, 2553
sleepers, 4652
social forestry, 3858
socio economics, 2433
soil conservation, 531, 539
soil deterioration, 226
soil erosion, 539, 1949
soil properties, 204, 205, 206, 278
spacing, 2045, 2340
species diversity, 123
stand characteristics, 3792
statistics, 3586
stem fusion, 680
stump planting, 1617
stump storage, 1699
stumpage value, 3365
survey, 3236, 3237, 3238, 3259, 3266, 3685
sustained yield, 3711, 3851, 3861
taungya, 2433, 2456, 2458
taungya crops, 141
taungya system, 2045
teak forests, 160, 205, 1053, 1136, 1997, 2012, 2057, 24
96, 2508, 2522, 2542, 3670, 3739, 3798, 3809, 3862
Teak sub commission, 4772
termite resistance, 4461, 4528
thinning, 2012, 2018, 2026, 3615
timber measurements, 3292, 3293
timber production, 3643
timber quality, 794, 2539
tissue culture, 1793
trade, 2057, 3902, 3922
transportation, 2488, 2508, 4764
undercrops, 2436
undergrowth, 123
underplanting, 130
understorey, 114, 131, 3615, 4744
utilisation, 2496, 4630
vegetative propagation, 1680
volume tables, 3736
water balance, 661
water conservation, 542
weeds, 2638
wood durability, 4453
wood properties, 3992, 3993
wood thefts, 2565
wood veneer waste, 4689
wood wool cement board, 4653
workers, 2544
working plan, 3614, 3615, 3626
Xyleborus destruens, 2803, 2944, 3023
Xyleutes ceramica, 3075
Xystrocera festiva, 3023
yield, 2026, 2271, 2542, 3524
yield tables, 3286, 3314

Industry
Australia, 3962
Bulgaria, 4427
construction, 3894
Ecuador, 3957
Europe, 3874
Indonesia, 3951, 3952, 3961, 3963
loading, 3952
marketing, 3951
Myanmar, 3950
sawmilling, 3950, 3961
Siam, 3946, 3947, 3948, 3949, 3953
Thailand, 3955, 3958
utilisation, 3874, 3957
Vietnam, 4427
working properties, 4427

Infection
seasonal variation, 476
vesicular arbuscular mycorrhizae, 476

Infestation
Hyblaea puera, 2962

Infiltration
soil water retention, 292

Infiltration capacity
soil compaction, 329

Infiltration rate
soil properties, 374

Inflorescence
Aphis gossypii, 3000
Kerala, 3000

Inheritance
clones, 761
progeny testing, 761

Inorganic fertilisers
seedlings, 2315

Insect attack
Xyleutes ceramica, 2870

Insect borer
Kerala, 2847

Insect control
genetic improvement, 3105

Insect outbreak
mixed plantations, 2872

Insect parasitoids
Hyblaea puera, 3170

Insect pests, 12, 2558, 2559, 2569, 3010, 3011
Assam, 2987
Bacillus thuringiensis, 3168
baculovirus control, 3173
Bangladesh, 2821, 3127
bibliography, 3010
Bihar, 2802
biological control, 2917, 3168
Brazil, 3035
burning, 309
clonal resistance, 4483
control, 2835, 2842
Cuba, 2965
cultivation, 3011
defoliation, 2917
defoliators, 3009
Dinoderus minutus, 2790
Draeculocephala cubana, 2965
ecology, 2842
economics, 12
Endoclita aroura, 2867
environmental impact, 309
Eutectona machaeralis, 3116
Hyblaea puera, 2867, 2916, 2923, 3035, 3116, 3168, 3173
identification, 3097
India, 12, 2842, 2848
Indonesia, 2992, 3010, 3101
insecticides, 2982
intensive management, 3116
Java, 2569
Kerala, 2975, 3012, 3020
Lantana, 2634
Maharashtra, 2905
Malaysia, 2867, 2868
management, 2918
marine borers, 2792
Myanmar, 2966
nurseries, 3113
Oiketicus, 2959
Olivea tectonae, 2794
Pakistan, 2861, 3127
Paliga damastesalis, 2867, 2923
plantations, 3020

protection, 2792
Pyrausta machaeralis, 2916
review, 2569, 3010
seed orchards, 3125
seeds, 2884
site factors, 3076
soil properties, 222
survey, 2559
Thailand, 222, 2559, 2917, 2918
weed control, 2634
wood properties, 12
Xyleutes ceramica, 2867, 2923
Zeuzera coffeae, 2353, 2793

Insect rearing
Corcyra cephalonica, 3030
Hyblaea puera, 2978, 3030
Trichogramma chilonis, 3030

Insect resistance
breeding, 924

Insect visitors
pollination, 819

Insecticides
Alcterogystia cadambae, 3208
Anomala, 3213
Bacillus thuringiensis, 3221
chemical properties, 4353
Cryptotermes brevis, 3227
fruit production, 3216
Hapalia machaeralis, 2857
Heterotermes tenuis, 3227
Holotrichia insularis, 3210
Holotrichia serrata, 3225
hormones, 3216
Hyblaea puera, 3205, 3217, 3221
insect pests, 2982
Lantana camara, 2857
leaves, 2857
Nasutitermes costalis, 3227
nurseries, 3213
Pyrausta machaeralis, 3204, 3223
Sahyadrassus malabaricus, 3215
seed orchards, 3216
tectoquinone, 4353
Tephrosia cinerea, 3218
Tephrosia noctiflora, 3218
termite damage, 3227

Insects
fruit yield, 831
Malaysia, 3691
pollination, 820, 2913

Instruments
DBH measurement, 3447

Insulating properties, 4028

Integrated pest management
Hyblaea puera, 3164
Pyrausta machaeralis, 3164

Intensive management
agroforestry practices, 2435
biomass, 2302
Cote d'ivoire, 3834
Eutectona machaeralis, 3116
fertigation, 2302
growth behaviour, 3841
Hyblaea puera, 3116
Indonesia, 3330
insect pests, 3116
investments, 3788
irrigation, 2302
Karnataka, 3788
Madhya Pradesh, 3740, 3841
Malaysia, 4578
management, 3740
mixed planting, 2435
productivity, 3330
quality timber, 3355, 4578

Intensively managed plantation
timber production, 3298

Interception
stemflow, 58

Intercropping
agri silviculture, 2438
agroforestry, 2363, 2413, 2440, 2458, 2468
agrosilvicultural systems, 2464
Andhra Pradesh, 2378
cash crops, 2413
cultivation, 1926, 2389, 2458
economics, 2464, 2479
food crops, 2437
Indonesia, 2045, 2271, 2340, 2437, 2458
irrigation, 2479
Karnataka, 2425
Leucaena glauca, 2364
Leucaena leucocephala, 2395
maize, 2468, 2469
Nigeria, 2468, 2469
NPK fertilizers, 2271
oil seeds, 2413
Rauwolfia serpentina, 2386
rice, 2389
salt tolerance, 2363
soil properties, 2395
spacing, 2045, 2340
Sri Lanka, 2440
Tamil Nadu, 2438
taungya, 2045, 2347, 2413, 2458, 2473
Thailand, 2347, 2464
turmeric, 2397
Uttar Pradesh, 2414
Venezuela, 1926
yield, 2271, 2363

Interlocked fibre
wood anatomy, 4117

Intermediate fellings
thinning, 2512

International cooperation
China, 16
Denmark, 928
provenance trials, 928
TEAKNET, 16
Thailand, 928

International effort
Brazil, 949
Danida Forest Seed Centre, 949
Ghana, 949
Puerto Rico, 949
Thailand, 949

International programmes
provenance trials, 1005

International provenance testing
seed germination, 1490

International Teak Commission
Indonesia, 4767

Interplanting
gap planting, 2455
green manures, 2370
growth, 2478
Java, 2343
Leucaena glauca, 2390, 2429, 2454, 2465
Madhya Pradesh, 2432
Philippines, 2379
sal, 2432
Tamarindus indica, 2385
taungya, 2343, 2385
teak forests, 2370
Thailand, 2385, 2478

Introduced species
Tanzania, 1123

Inventory
aerial surveys, 3239

India, 3256
Indonesia, 3247
Myanmar, 3250, 3251, 3264
screenometer, 3252
teak forests, 3262
Thailand, 3229, 3242, 3244, 3245, 3246
Trinidad and Tobago, 3235

Investments, 3813
Andhra Pradesh, 1947
Caribbean, 3712
Central America, 3712
Colombia, 3712
Costa Rica, 3642, 3701, 3775, 3782, 3783
Cote d'Ivoire, 3743
country reports, 37
economic assessment, 3800
economic returns, 1096
economics, 3606, 3709, 3725, 3726, 3727, 3730, 3769
Ecuador, 3593
exotic trials, 2401
financial rotation, 3811
Government teak plantations, 3772
Gujarat, 3751
Ibadan fuel plantations, 3813
India, 3607, 3624, 3682, 3717, 3762, 3770, 3772
Indonesia, 3626, 3809
intensive management, 3788
irrigated plantations, 1947
Karnataka, 3726, 3727, 3788
Kerala, 3744, 3796
Madhya Pradesh, 3800
Maharashtra, 3680, 3710, 3720, 3754, 3778
Malaysia, 37, 3723, 3753
management, 3840
marketing, 3743, 3795
Myanmar, 3596
NABARD, 3686
Netherlands, 3629, 3772
plantation establishment, 3720
plantation schemes, 3751
plantations, 3730
prices, 3680
private companies, 3680
productivity, 3523, 3606, 3796
quality timber, 3721
rotation, 3727, 3777
silviculture, 3779, 3782, 3796, 4032
Singapore, 3795
site quality, 3523
social forestry, 3724
sustainable management, 3783
sustained yield, 3725, 3744
Tamil Nadu, 3751
Tanganyika, 3749
teak forests, 1096, 3791, 3809
Thailand, 3724, 3757, 3793
timber quality, 3629, 4032
Togo, 3779
Trinidad and Tobago, 2401
tropical forestry, 1096
Venezuela, 3712
working plans, 3626
yield, 3642, 3680, 3726, 3727, 3744, 3779

Ipomea carnea
fire protection, 2593

Iran
marketing, 3930

Ireland
imports, 3883

Irish republic
sustained yield, 3388

Iron
litter, 412
wood properties, 4058, 4375

Irpex flavus
wood destroying fungi, 2737

Irregular growth, 3362

Irrigated plantations, 1947
economic returns, 3707
economics, 2316
farm forestry, 300
fertigation, 2287
growth rate, 2293
growth, 3707
Hyblaea puera, 2963
productivity, 2289
sewage water, 2288
soil properties, 300
yield, 2316

Irrigated stands
planting density, 3436
yield, 3435, 3436

Irrigation, 2272
biomass, 2302
economics, 2479
fertigation, 2276, 2302, 2305
fertilizers, 2276, 2305
growth periodicity, 728
intercropping, 2479
productivity, 2305
timber quality, 728

Isoenzymes
clonal identification, 782
leaf peroxidases, 858
outcrossing rate, 818

Isolation
quinones, 4379

Isoquant method
logging, 2486

Isozyme analysis
gene diversity, 937

Isozyme variation
genetic variation, 779

Itonididae cecidmemyildal
gal formation, 2890

IUFRO
micropropagation, 1758
provenance trials, 866, 873

Ivory Coast
afforestation, 535, 1902
plantation establishment, 1109, 1887, 1953, 2160
provenance trials, 878, 879
regeneration, 2023
rehabilitation, 535
savanna, 535, 1902, 2160
silviculture, 1887
species introduction, 1109, 2160

Izod values
wood properties, 4277, 4374

Japan, 1303
anatomy, 630
caout chouc, 628, 629, 630
country reports, 29
grading, 4580
natural regeneration, 1303
protoplast isolation, 610
rotation, 2132

Java, 90, 539, 726, 779, 1617, 1836, 1940, 2339, 2445, 2488, 2491, 2516, 2525, 2532, 3706, 3922, 3954, 3985, 4168
afforestation, 1944
clonal origin, 975
costing system, 2525

cultivation, 1803, 1805, 1812, 1822, 1836, 1852, 1935, 1940, 1957, 2338, 2445
cutting cycle, 2503
dendrochronology, 726
Diospyros celebica, 2339
diseases, 2569
durability, 4482
economics, 975
exports, 3965
felling, 30, 2515, 2516, 2524, 2541, 2554, 3584
fires, 2606
forest village system, 3954
genetic variation, 779
girdling, 2500
grading, 3584
growth rings, 717, 726
growth, 975
harvesting, 2489, 2491, 2507
Hindoos, 1058, 1066
imports, 1058
insect pests, 2569
interplanting, 2343
isozyme variation, 779
k. stump puller, 2554
logging, 2491, 2525, 3954
machine, 2515
management, 2038, 2121, 3617, 3673
mechanization, 2516
mixed cropping, 1169, 2339
mixed plantations, 2445
Neotermes tectonae, 2806, 2941
plantation establishment, 1877
plantation raising, 2172
plantation techniques, 2007
plantation trials, 2339
plantations, 1803
planting, 1852
production, 1960
protection, 2606
Pyrausta machaeralis, 2936
railways, 2506
rainfall, 717
regeneration, 1169, 1254, 1255, 1338, 1940
regreening programme, 1944
review, 2569
roads, 2506
rotation, 2016, 2019, 2061
seed origin, 975
silvicultural techniques, 2017
silviculture, 1177, 1960
site classification, 90
soil conservation, 539
soil erosion, 539
soil properties, 207, 208
spacing, 2007
species diversity, 113
species selection, 754
stump planting, 1617
taungya, 2338, 2342, 2343, 2361
teak forests, 1057, 1069, 1115, 2016, 2017, 2019, 2061, 2503, 2506, 2532, 3585
temperature, 2806
thinning, 2096, 2206
timber production, 3965
trade, 3922
transportation, 2488
tumpangsari method, 1877
underplanting, 2338
understorey, 115, 126
wildlife conservation, 2121
wood properties, 3985, 3987
World market, 3944
Xyleborus destruens, 2945
yield tables, 3576
yield, 3584

Jivrajbhal Patel Agroforestry
cultivation, 1918

Joints
wood properties, 4289, 4392

Juvenile wood, 4053, 4085
cambial activity, 673
decay resistance, 4462
defoliation, 4129
durability, 4087
fast grown timber, 3983, 4087
furniture, 4141
growth rings, 673
mechanical properties, 4181
physical properties, 4181
plantation grown teak, 4053, 4462
timber quality, 3983, 4163
wood anatomy, 673, 4129
wood properties, 4085, 4093

K. stump puller
felling, 2554

Kambala teak
eczema, 599

Kanara plantations
regeneration, 1354
stump planting, 1848

Karnataka, 281, 285, 576, 779, 3454, 3727, 4339
agroforestry, 2416, 2417, 2418, 2419, 2420, 2421
agrosilvopastoral systems, 2422
artificial regeneration, 1269, 1270
biomass, 2303
caout chouc, 4339
climatic factors, 450
clonal multiplication, 1787
clones, 897
defoliators, 2852, 2950
distribution, 1068
durability, 4463
economic evaluation, 2416
economics, 3726, 3727
Eutectona machaeralis, 2950, 3024
fertigation, 2303, 2304, 2304, 2305
fertilizers, 2305, 2314, 2315
field performance, 2260
financial analysis, 3726
fruiting, 897
Ganoderma lucidum, 2719
genetic improvement, 855, 961
genetic variability, 984
genetic variation, 744, 779, 897
geology, 281
groundnut, 2418
growth rate, 3398
growth rings, 3398
Haliyal teak pole forests, 3827
Hapalia machaeralis, 2830
Hyblaea puera, 2830
inorganic fertilisers, 2315
intensive management, 3788
intercropping, 2425
investments, 3726, 3727, 3788
irrigation, 2305
isozyme variation, 779
landsat MSS data, 3254, 3454
litter fall, 450, 466
litter production, 451, 3297
management, 3598
mechanical properties, 4156
mixed cropping, 2417, 2418, 2419, 2420, 2421
Myllocerus subfasciatus, 2950

nail holding properties, 4396
nurseries, 1641
nutrient deficiency, 285
nutrient return, 451
nutrients, 466
physical properties, 4156
phytochemistry, 576
plantations, 93, 332, 333, 334, 1270
population dynamics, 3028
prices, 3932
productivity, 2305, 2422, 3402
provenance trials, 921
Pyrausta machaeralis, 3026, 3027, 3028
remote sensing, 3254, 3454
resource survey, 3241
rotation, 3727
seasonality, 3297
seed germination, 1524
seed origin, 921
seedlings, 285, 2314, 2315
ship building, 4390
site quality, 93
soil nutrients, 334
soil properties, 178, 227, 281, 332, 333
Sorghum bicolor, 2421
species composition, 178
species diversity, 134
status report, 28
thermal conductivity, 4440
tissue culture, 1787
tree age, 1524
underplanting, 2396
vegetation, 227
vertisol, 227
Western Ghats, 2260
working plan, 3827
yield, 3726, 3727

Keen's method
classification, 4609

Kerala, 1, 5, 6, 279, 347, 394, 453, 744, 855, 1033, 1074, 2426, 2660, 2749, , 3605, 3369, 3747
abnormalities, 710
age, 86, 728
agroforestry, 2356, 2357, 2426
Alcterogystia cadambae, 2976
Aphis gossypii, 3000
Arbuscular mycorrhizal association, 498
architectural analysis, 2357
architecture, 2356
Aspergillus, 454
Bambusa arundinacea, 2354, 2355
bark, 4090, 4165
biomass, 3386
branches, 4166
bulk density, 384
cambial activity, 673
carbon, 188, 192
chemical control, 2647
chlorophyll deficient seedlings, 1401
clones, 4198
Coniella, 454
Conolly teak plantations, 3747
Cossus cadambae, 2977
data bank, 3373
defoliation, 3019
defoliators, 3008
demand and supply, 3916, 3917
dendrochronology, 727
density management diagram, 3400
diseases, 2749, 2750, 2775
distribution, 14
durability, 4087
ecological studies, 2355
economic impact, 2661
economics, 3699, 3745, 3758, 3833
epicentres, 3019
Eupatorium odoratum, 2660
fast grown timber, 4082, 4083, 4087
fertilization, 2266
fertilizer trials, 196
fires, 2594, 2595
firing, 2594
flowering, 820
forest management, 3832
forest types, 1074
fruit production, 817
fungi, 454
genetic improvement, 855, 914, 1038
genetic variation, 744, 860
giant timber, 550, 3354, 3369
growth, 218, 2356, 2357, 3487
growth periodicity, 728
growth rings, 673, 4081
Halictus, 821
heartwood proportion, 4081
height diameter curves, 3374
history, 2166
home gardens, 2356, 3399
host-parasite relationship, 2647
Hyblaea puera, 2998, 3008, 3019
inflorescence, 3000
insect borer, 2847
insect pests, 2975, 3012, 3020
insect visitors, 819
insects, 820
investments, 3744, 3796
irrigation, 728
juvenile wood, 673, 4085, 4087
Konni teak plantations, 171, 2166
laterite soil, 235
leaf blight, 2627
leaf morphology, 1049
leaf nutrients, 394
leaf sampling, 597
leaf spot diseases, 2698
leaves, 685
litter decomposition, 453, 454, 455, 464
management, 3605, 3627, 3668, 3768, 3838, 3849
Mikania micrantha, 2661
mistletoe, 2627, 2647, 4190
mixed plantations, 197, 2354, 2355
monoculture plantation, 194, 197
morphology, 685, 710, 2582
natural forests, 157
natural regeneration, 1341
Nilambur, 235, 1180, 2254, 2582
Nilambur plantations, 2003, 2253, 2254, 2266, 4779
nitrogen, 192
nurseries, 2698, 2749, 2750, 2775
nutrient analysis, 597
nutrients, 464
Odontaleyrodes splendens, 2878
Odontaleyrodes, 2878
penicillium, 454
phanerogamic parasite, 2647
phyllotaxy, 677

plantation establishment, 3760
plantation grown teak, 4084, 4088
plantations, 157, 180, 182, 186, 187, 188, 192, 195, 196, 197, 2661, 2775, 3020, 3605, 3704, 3745, 3758
plus trees, 1033
pollination, 817, 819, 820
pollinators, 821
prices, 3915, 3917, 3918, 3919, 3920, 3921
productivity, 394, 498, 3377, 3487, 3605, 3796, 3833, 3849
provenance trials, 917
reed, 2459
regeneration, 1341
reproduction, 1295
research, 5, 1180
resource economics, 3704
resources, 3399
ring formation, 727
root activity, 703
root growth, 384
root termites, 3103
root trainers, 2749, 3103
rotation, 86, 192, 3487
seed germination, 917, 1049, 1401, 1472, 1473, 1585
seed size, 1473
seed sources, 1472
seed treatment, 1585
seedling growth, 1658
seedling survival, 1472
seedling vigour, 1473
seedlings, 710, 3103
seeds, 1295
selection criterion, 860
seminar proceedings, 1
shade, 1658
silviculture, 14, 316, 1180, 1216, 3679, 3796
site factors, 4198
site preparation, 347
site quality, 86, 172
slash burning, 217, 218, 347
soil chemistry, 187, 188, 192
soil conservation, 316, 2459
soil density, 384
soil erosion, 316
soil fertility, 316
soil moisture, 384
soil nutrients, 196, 394, 2595
soil organic matter, 189
soil properties, 171, 172, 180, 182, 185, 186, 189, 194, 195, 197, 217, 218, 279, 347
spacing, 2254
specific gravity, 860, 4164, 4165, 4166
stand density, 3370
status report, 42
stock estimation, 3375
stomates, 685
stump transplanting, 2189
sustainable production, 3760
sustained yield, 3744
taungya, 218
teak forests, 551
thinning, 1992, 1994, 2003, 2072, 2253
timber quality, 728, 860, 3627, 4084, 4088
Travancore, 550, 1049, 2189
Tritirachium, 454
undercrops, 2426
underplanting, 2459
utilisation, 14, 4640
vanalakshmi, 2426
Vitex altissima, 2998
volume estimation, 3374
water blister, 2166, 2579, 2580
weed growth, 218
weeds, 2660
wildlife habitat, 157
wood anatomy, 673
wood density, 4081, 4198
wood properties, 4082, 4085, 4190
wood quality, 860, 4083
wood structure, 728, 4090
Wyanad, 1295, 1992, 1994, 2072
yield, 3744

Kernel formation, 2709

Kiln drying, 4570
discoloration, 4551
seasoning behaviour, 4560
wood defects, 4569

Kilombero valley teak company
marketing, 3620

Klangdong teak plantation
soil chemistry, 284
stem analysis, 3537

Knotty teak
wood defects, 2588

Konni teak plantations
history, 2166
soil properties, 171
water blister, 2166

Korai teak forest
yield, 3647

Kumri crops
growth, 2333
mixed cropping, 2330

Kumri teak plantations, 3738

Kurseong forest division, 3755

Kyetpyugan teak plantation
plantation techniques, 2006

L.A.P Luxmeter
light intensity, 349

Labelling
certification, 4605

Labour
management, 3845

Laminated window frames, 4706

Laminated wood
bending strength, 4335
bonding quality, 4715
properties, 4150

Lampang teak plantations
site quality, 110

Landolphia calabarica
understorey, 128

Landsat digital data
remote sensing, 3240

Landsat MSS data
canopy diameter, 3454
identification, 3260
Karnataka, 3254, 3454

Lantana
insect pests, 2634

Lantana bug
defoliation, 2898
Teleonemia scrupulosa, 2898

Lantana camara, 2857
Australia, 2911
biological control, 2659
weed control, 2651, 2911

Lantana camara var. *aculeata*
antifeedant property, 3156

Laos, 3
agrosilvicultural systems, 2441
allozyme diversity, 950

breeding, 907
country reports, 29
farm forestry, 2441, 3595
genetic improvement, 906
genetic variation, 744, 781, 950
plantation establishment, 95
seeds, 907
teak forests, 1147

Laos-Australian reafforestation, 1888

Lapachol
Alternaria tenuissima, 619
conidial germination, 619

Larvae
Hyblaea puera, 2869

Laterisation, 260
review, 257
soil properties, 253, 254, 261

Laterite soil
Bengal, 198
growth, 304
India, 371
Kerala, 235
Myanmar, 163
Nilambur, 235
plantations, 163, 164
soil properties, 198
West Bengal, 371

Lateritic belt
West Bengal, 368

Lateritic soil
species trials, 221

Lateritic waste, 1864

Latin America
plantations, 3231
yield tables, 3551
yield, 3352

Lead
Dangs forest, 315

Leaf abscission, 695

Leaf analysis
nutrient deficiency, 631

Leaf area estimation
seedlings, 3438

Leaf blight
mistletoe, 2627

Leaf cutting ants, 2866

Leaf deformation
leaf hopper, 2828

Leaf extract
germination inhibition, 594
seedling growth, 607

Leaf flushing phenology, 3003

Leaf galls, 2910

Leaf gas exchange
leaf position, 652

Leaf growth pattern, 649

Leaf hopper
leaf deformation, 2828

Leaf leachates
seed germination, 602

Leaf litter
decomposition, 430
Gliocladium, 449
Heterocephalum aurantiacum, 449
Phoma leveillei, 449
rainfall interception, 65

Leaf meal
fodder, 4721

Leaf moisture
clonal resistance, 4506
Eutectona machaeralis, 4506

Leaf morphology
clones, 686
seed germination, 1049

Leaf nutrients
productivity, 394

Leaf peroxidases
clones, 858

Leaf position
chemical composition, 571
leaf gas exchange, 652

Leaf rust
Olivea tectonae, 2783
Uredo tectonae, 2783

Leaf sampling
nutrient analysis, 597

Leaf spot disease
Phomopsis tectonae, 2786

Leaf spot diseases
nurseries, 2698

Leaf water potential
shade, 638
stomatal conductance, 638

Leaf weight
age, 715
sapwood, 3335

Leaves, 74, 407, 408, 409, 423, 431, 437, 443, 448, , 460, 467, 575, 588, 589, 591, 592, 610, 613, 642, 685, 693, 2799
abnormalities, 714, 750
acid deposition, 74
allelopathy, 577
alluvial soils, 592
amino acids, 620
anatomy, 681
anthraquinone naphthoquinone, 568
arthropod fauna, 429
ash, 591
Aularches scabiosae, 2927
basal area, 3525
biochemistry, 2927
boundary layer conductance, 642
calcium, 210
chemical analysis, 570
chemical composition, 407, 409, 613
colouring matter, 567
decomposition, 448
digestion, 2994
dyestuff, 616
ecology, 681, 693
Eutectona machaeralis, 2994
fodder, 588, 589, 4746, 4750, 4754, 4760
foliar, 210
foliar constituents, 613
fossil leaf, 467
fungi, 448
Hapalia machaeralis, 2857
Hyblaea puera, 2994
insecticides, 2857
Lantana camara, 2857
lime, 407
litter, 419, 431, 437
litter decomposition, 423, 425, 429, 460, 600
litter production, 443
lobed leaves, 714
metals, 570
mildew, 2784
morphology, 669, 681, 685, 702, 707, 1007
nitrogen, 584
nutrient concentration, 3525
nutrient contents, 592
nutrients, 425, 591, 600

nutritive value, 408, 588, 589
particle boards, 4740
phenolic compounds, 2734
phenological behaviour, 693
phyllotaxy, 711
physiology, 647, 2770
powdery mildew infection, 2734
protoplast isolation, 610
provenance identification, 1007
seed germination, 577
silage, 408, 409
soil chemistry, 419
soil properties, 210
stomates, 685
tannins, 575
tectograndone, 568
tectoleafquinone, 567
tree volume, 3525
Uncinula tectonae, 2770, 2784
water use efficiency, 647
wood chemistry, 210
Zonocerus variegatus, 2799

Lecaniodiscus cupanioides
ecological indicator, 128
understorey, 128

Leguminous creepers
growth, 2331

Length, 3583

Lentinus edodes
sawdust, 4761

Leptobyrsa decora
biological control, 2659, 2995

Leucaena
underplanting, 117

Leucaena glauca
interplanting, 2364, 2390, 2429, 2454, 2465
mixed planting, 2446, 2476
underplanting, 2348

Leucaena leucocephala
intercropping, 2395

Liberia
reforestation, 1909
site factors, 3582
soil nutrients, 88, 242
soil properties, 242, 243
yield, 88

Light
branching, 648
flowering, 648
seed germination, 1540

Light intensity
L.A.P Luxmeter, 349
seedling growth, 1447

Light tolerance, 79

Light traps
Eutectona machaeralis, 2871, 2964
Hyblaea puera, 2844, 2871, 2964
population dynamics, 2871, 2964
Pyrausta machaeralis, 2844

Lignin contents
crushing strength, 4183

Lignins
hydrogenolytic degradation, 4318

Lignocellulosics
pulps, 4318

Lime
leaves, 407
soil properties, 291

Limnoria bombayensis
resistance, 4517

Line planting
plantation establishment, 1946

Litter
biochemical cycling, 439
chemical composition, 424
iron, 412
leaves, 419, 431, 437
nitrification, 411
nutrient concentration, 459
nutrient conservation, 439
nutrient return, 413, 421, 422
nutrients, 416
organic matter, 416
soil chemistry, 411, 412, 419
spacing, 456
stand density, 456

Litter cover
soil properties, 104

Litter decomposition, 415, 428, 438, 455, 462
arthropod fauna, 429
Aspergillus, 454
carbon dioxide evolution, 463
chemical composition, 468
Coniella, 454
epigeic earthworms, 496
fungi, 454
hydrology, 444
in vitro digestibility, 410
leaves, 423, 425, 429, 460, 600
microbial activities, 463
mineralization, 414
nutrient return, 418, 436
nutrients, 405, 418, 425, 438, 464, 468, 600
organic matter, 452
Penicillium, 454
plantations, 433, 434, 440
rainfall, 444
seasonal variation, 446
soil fungi, 446
soil microorganisms, 452
soil moisture, 275
soil properties, 452, 465
tritirachium, 454
undergrowth, 465
urea lime treatment, 410

Litter fall
climatic factors, 450
nutrient contents, 2181
nutrient return, 432
nutrients, 466
spacing, 2181

Litter production, 426, 447
Gir forest, 442
leaves, 443
nutrient return, 451, 458
nutrients, 469
seasonal variation, 3326
seasonality, 3297
soil chemistry, 442

Litter productivity
dry deciduous forests, 445

Liver lipids
seed protein, 605

Lixus camerunus
Nigeria, 2883

Loading
industry, 3952

Loam soils
moisture distribution, 273

Lobed leaves
abnormalities, 714

Log splitting, 4398

Log volume
soil depth, 395

Logging, 2501, 3752
animals, 2533

costing system, 2525
harvesting, 2491, 2523
Indonesia, 2491, 2510, 2517, 2525, 2546, 3643, 3954
isoquant method, 2486
Java, 2491, 2525, 3954
mechanization, 2486
Thailand, 2545
Venezuela, 2520

Logs
processing, 4393
qualitative analysis, 3532

Longicorn borer
Monohammus rusticator, 2937

Longitudinal splitting
stumps, 1605

Loranthaceae
mistletoe, 2626

Loranthus
site factors, 2667
weed control, 2628, 2640, 2643, 2657

Low fruit production
clonal seed orchard, 896

Lumber processing
Papua and New Guinea, 4185

Lygropia quaternalis
biological control, 3137

Mac huat teak plantations
genetic improvement, 1030

Machine, 4205
felling, 2515
seed extraction, 1454
seed processing, 1461
seed treatment, 1406

Machining properties, 4401
seasoning, 4036
working properties, 4199

Macropropagation
rooting, 1763

Madagascar
achievements, 3857
forest policy, 2332
microbiology, 499
soil chemistry, 499
wood properties, 3964

Madelena project
Central America, 1146
Costa Rica, 1146, 1219
El salvador, 1221
Honduras, 1218
Nicaragua, 1220
Panama, 1222
species trials, 1146

Madhya Pradesh, 56, 320, 354, 355, 387, 389, 403, 2906
adventitious rhizogenesis, 1675
arbuscular mycorrhizae, 517
artificial regeneration, 1280
ascorbic acid, 1675
bacterial wilt, 2757
biomass, 3469
brandis system, 3488
calcium, 402
chemical composition, 407, 409
clones, 518, 889, 1785
coppice system, 2233
Coptotermes heimi, 3049
defoliation, 2993
distribution, 55, 1135
drip irrigation, 2296
dry deciduous forests, 445
dying back, 1349
ecology, 56, 152
economic assessment, 3800
economic returns, 3601
elevation, 2844
emptiness, 1542
fertilizer trials, 2312
fodder, 588, 589
foliar analysis, 596
Forest Development Corporation, 3786
forest types, 1145
fruits, 1542, 2711
fuelwood, 3886
fungi, 2711
genetic improvement, 889, 953
geography, 96
gibberellic acid, 1700
grading, 953
grafting, 1785
green manures, 147
ground flora, 119
growth, 889, 1372, 1700, 2202, 2296
growth behaviour, 3841
growth rate, 3421
hardening, 1786
heart rot, 2724
Hyblaea puera, 2844, 2906
hydrology, 168, 545, 546, 547
intensive management, 3740, 3841
interplanting, 2432
investments, 3800
leaves, 407, 408, 409, 431, 575, 588, 589
light traps, 2844
lime, 407
litter decomposition, 418, 436
litter production, 426
litter productivity, 445
litter, 413, 431
management plan, 3601
management, 1210, 2119, 2233, 3625, 3740
microflora, 480
micropropagated shoots, 1786
mine restoration, 1924
minerology, 240, 387
mixed forests, 1353, 2345, 2410
mixed plantations, 96, 120
mortality, 320
mycorrhizal colonisation, 518
natural regeneration, 1268, 1280, 1294, 1340, 1349, 2233
natural succession, 1143
niche measurement, 1160
nutrient contents, 596
nutrient cycling, 435
nutrient return, 413, 418, 436
nutrients, 240, 403, 418
nutritive value, 408, 588, 589
Odontotermes parvidens, 3049
Odontotermes redemanni, 3049
phytochemistry, 595
plant diversity, 1159
plantation techniques, 2196
plantations, 119, 224, 490
plywood, 4712
prices, 3886, 3935, 3936
productivity, 119, 3383
provenance tests, 1028
provenance trials, 868
Pseudomonas tectonae, 2757
Pyrausta machaeralis, 2844
reclamation, 1924
regeneration, 1143, 1159, 1271, 1325, 1353, 1357, 1372, 143, 2233
review, 595
rhizosphere microflora, 480

root system, 651
rooted cuttings, 1690, 2081
rooting, 1786, 2081
seed germination, 1542, 1564
seed orchards, 953, 1011, 1785, 2434
seed storage, 1477
seed viability, 1477
seedling age, 1690
seedling growth, 517
seedlings, 477, 518, 1700
silage, 408, 409
silvicultural techniques, 152
silviculture, 55, 1011, 1210, 1325, 1357, 1372, 2119
site characteristics, 321
site factors, 56, 96
site quality, 87
site selection, 331
soil chemistry, 320, 354, 355, 389, 402
soil nutrients, 147
soil productivity, 388
soil properties, 55, 211, 224, 240, 280, 321, 331, 355, 387, 388, 403, 2202
species diversity, 116, 119, 120, 143, 1160
stemflow, 545, 546, 547
stocking, 2536
storage containers, 1477
stump planting, 1924
stylosanthes, 2434
succession, 1165
superior phenotypes, 953
synecology, 1159
tannins, 575
teak forests, 116, 211, 1112, 1135, 1143, 1210, 2195, 2233, 3232
thinning, 2195
throughfall, 545, 546, 547
transportation, 2528
tree health, 2567
Tropical dry deciduous forests, 547
underplanting, 2434
vam fungi, 490
vegetation, 54
vegetation composition, 143
vegetation ecology, 155
vegetation types, 1112, 1165
veneering industry, 4712
vesicular arbuscular mycorrhizae, 477, 517, 518
volume tables, 3319, 3742
weathering, 2711
weed control, 2434
wildlife, 152
wildlife management, 155
yield regulation, 3488

Madras
artificial regeneration, 1381

Madura
cultivation, 1852

Mae Huad teak plantation
growth, 336, 337
height, 373
nutrients, 346
soil chemistry, 378
soil depth, 336, 337, 373
soil nutrients, 379
soil organic matter, 379
soil properties, 346, 378
Thailand, 336, 337, 346, 373, 378, 379

Mae Ngao forest
Thailand, 3817

Magersaren, 72

Maharashtra, 168, 959, 1015, 1637, 3680, 3710, 3886
acanthophorus, 2909
aerial assessment, 3248
afforestation model, 1942
agroforestry, 2346
artificial regeneration, 1270
bamboo, 2373
biodiversity, 1942
clay minerology, 238
clones, 761, 959
coppice, 1802
culling, 1665
Deccan plateaux, 1352
degraded forests, 1878
economic assessment, 3780
emptiness, 1436
Eutectona grandis, 2904
fertigation, 2287
fertilizers, 2297
field trials, 2262, 2263
Forest Development Corporation, 1659
fossil leaf, 467
fruits, 1436
fuelwood, 3886
genetic improvement, 890, 960, 1003
genetic resources, 988
genetic variation, 1015
giant timber, 3342
grafting, 1802
greening, 1878
growth rate, 2293
growth regulators, 2292
hydrology, 168
infection, 476
inheritance, 761
insect pests, 2905
investments, 3680, 3710, 3720, 3754, 3778
irrigated plantations, 2287, 2288, 2293
leaves, 467
management, 3678, 3790
mechanical properties, 4258, 4259
melghat forests, 1362
mixed cropping, 2346
mixed plantations, 2451, 3780
moist deciduous forests, 1352
natural regeneration, 1310, 1352, 1362
nurseries, 1657
nursery management, 1659
nursery practices, 1637
physical properties, 4258, 4259
phytosociology, 1092
plantation establishment, 3720
plantation raising, 1636
plantation techniques, 1657
plantations, 69, 1270, 2109, 2297, 2373
planting stock, 1638, 1665
planting, 1638
plus trees, 958, 2262
pollination, 824
prices, 3680, 3886
private companies, 3680
productivity, 3499
progeny testing, 761, 959, 1015
regeneration, 1335
root trainers, 1636, 1637, 1638
rooting, 1802
sampling, 3249
sand minerology, 239
santalum album, 2451

seasonal variation, 476
seed improvement, 957
seed orchards, 870, 957, 958, 969, 2909
seed production areas, 969
seedling growth, 1665, 2292
sewage water, 2288
shoot cuttings, 1802
silviculture, 2109
soil degradation, 237
soil fertility, 239
soil properties, 237, 238
somatic embryogenesis, 1734
species diversity, 69
stump planting, 1636
teak forests, 1335, 2570, 3790
Thana malki, 3847
tissue culture, 1734
tissue cultured plants, 2262, 2263
vegetative propagation, 958, 1802
vesicular arbuscular mycorrhizae, 476
volume analysis, 3426
working plan, 3847
yield, 3680

Mahi ravines
management, 3763

Maize
intercropping, 2468, 2469

Malabar
conolly teak plantations, 3747
giant timber, 3369
Kerala, 3369, 3747

Malabar teak
Indonesia, 1113

Malawi
seed germination, 1526, 1527

Malaya
avenue plantation, 1844
Coptotermes curvignathus, 2947
defoliation, 2989
Eurema hecabe, 2989
growth rate, 1141
machining properties, 4401
nursery techniques, 2014
plantation establishment, 1961
plantation raising, 1962
planting stock, 1961
progeny trials, 1045
provenance trials, 1045
seed orchards, 929
silviculture, 1961, 1962, 2014
species introduction, 1071
species trials, 1141
teak forests, 1133
timber quality, 4151
volume tables, 3496, 3497
wood properties, 4291
Zeuzera coffeae, 2988

Malaya peninsula
flora, 564

Malaysia, 312
Acherontia lachesis, 3034
bacterial diseases, 2746
biotechnology, 1685
chemical composition, 571
clonal propagation, 1754, 1755
clones, 1754
country reports, 37, 51, 2133
cultivation, 1964
density, 4209
density variation, 4209
diseases, 2741
elephant habitat, 156
Endoclita aroura, 2867
Endoclita gmelina, 2880
fertility evalulation, 571
fungal diseases, 2746
grading, 4612
growth, 1227, 2173
growth performance, 3290
Hyblaea puera, 2867
in vitro culture, 1752
insect pests, 2867, 2868, 3691
intensive management, 4578
investments, 37, 3723, 3753
leaf position, 571
mechanical properties, 4251
micropropagation, 1685
mixed cropping, 2133
Paliga damastesalis, 2867, 2922
peninsular Malaysia, 302
photosynthesis, 646
physical properties, 4251
plantation establishment, 1868, 1874, 1874, 1883, 1936, 1964, 2133
plantation grown teak, 4209, 4611
plantations, 1227
planting stock, 1754
productivity, 3395
propagation, 1752
quality timber, 4578
rooted cuttings, 1755
sawing, 4284
sawnwood, 4612
seminar proceedings, 1964
silvicultural management, 2122
site classification, 312
site technology, 3395
social forestry, 1868
soil properties, 173, 174
soil survey, 173
stem borers, 2908
teak forests, 156
thinning intensity, 2173
thinning materials, 4251
timber certification, 4579
timber quality, 4611
tissue culture, 1753
tissue culture protocols, 1707
vegetation map, 3261
vegetative propagation, 1707, 1753
volume tables, 3390
water use efficiency, 646
wood destroying fungi, 2771, 2772
wood quality, 4612
Xyleutes ceramica, 2867, 2908
yield, 3290

Maleic anhydride treatment
chemical properties, 4412

Mammals
fruit damage, 1483
wildlife habitat, 153

Management
afforestation, 3822
Africa, 1999, 3621
Andamans, 3863
Annamlai, 3848
Asia, 2108
Asia Pacific, 3822
Bangladesh, 2826, 3765, 3852
Belgium, 3676
Benin, 1999
bibliography, 3713
Burma, 3824
Caribbean, 3713
Central America, 3713
China, 16
Colombia, 3713
conservation, 3860
coppice system, 2233
coppiced plantations, 2002

country reports, 49, 50
Cuba, 2159
database, 3661
density, 3705
Dutch East Indies, 3640
economics, 1568, 3850
ecosystems, 1055
Eucador, 3611
Eutectona machaeralis, 2826
French West Africa Federation, 2023
genetic improvement, 854, 1568
genetic resources, 854
growth, 2239
history, 3789, 3846, 3866
Hyblaea puera, 2826
India, 2, 49, 1185, 2108, 2220, 3605, 3622, 3645, 3689, 3839, 3850, 3866
Indonesia, 50, 2108, 3612, 3614, 3628, 3656, 3657, 3658, 3661, 3693, 3694, 3711, 3789, 3797, 3798, 3814, 3842, 3845, 3846, 3858, 3859, 3860, 3861, 3864
insect pests, 2918
intensive management, 3740
international cooperation, 16
investments, 3840
ivory coast, 2023
Java, 2038, 2121, 3617, 3673
Karnataka, 3598
Kerala, 3605, 3627, 3668, 3768, 3838, 3849
labour, 3845
logging, 3752
Madhya Pradesh, 1210, 2119, 2233, 3625, 3740
Maharashtra, 3678, 3790
Mahi ravines, 3763
management, 3605
Myanmar, 854, 1185, 2108, 3632, 3633
natural regeneration, 2233
Nigeria, 2015, 2024, 3589, 3597
Nilambur, 3848
Nimbia timber plantation project, 2015
North America, 3713
Pakistan, 1185, 3650
Papua and New Guinea, 1948
plantation establishment, 1915, 2239
plantation techniques, 2024, 2131, 2159, 2187
plantations, 1999, 2047, 3605
planting evaluation, 3688
productivity, 3605, 3676, 3705, 3849
profitability, 3765
Puerto Rico, 3591
quality timber, 2047
reforestation, 1948
regeneration, 2023, 2233, 3803
Rembrangsche teak forest, 2035
research, 2239
review, 2056
rotation, 3705
seed germination, 2239
seed origin, 2220
seed production areas, 972
seed treatment, 2239
seeds, 1568
seminar proceedings, 2
silvicultural problems, 2047
silviculture, 2, 16, 49, 1185, 1210, 1972, 2013, 2056, 2066, 2107, 2108, 2119, 2220, 2239, 3594
social forestry, 3858
soil properties, 2220
South East Asia, 2107
Sudan, 2066
sustained yield, 3711, 3861
Tamil Nadu, 3801
Tanzania, 1870
teak forests, 1210, 2037, 2039, 2233, 3790, 3798, 3801, 3807, 3823, 3826
TEAKNET, 16
Thailand, 1185, 2013, 2108, 2239, 2918, 3610, 3649, 3690, 3836
timber quality, 3627
TIV plantations, 2024
Trinidad and Tobago, 3829
underplanting, 3591
Venezuela, 3713
wildlife conservation, 2121
working plan, 3614, 3636
yield, 1972, 3697
Zaire, 2187

Man made forests
- Indonesia, 1997
- plantations, 258
- teak forests, 1997

Management plan
- Madhya Pradesh, 3601
- Myanmar, 3603

Management strategy
- farm forestry, 2344
- *Hyblaea puera*, 3013

Manipur
- biochemistry, 4315
- forest types, 1077

Maniram teak plantation
- Chattisgarh, 3844

Mapping
- Indonesia, 3266
- landsat digital data, 3240

Marine borers
- bibliography, 3061, 3062
- crustaceans, 3078
- durability, 4505, 4520
- Myanmar, 2891
- natural durability, 4478
- natural resistance, 4518, 4519, 4526
- protection, 2792
- resistance, 4563

Marine trials
- utilisation, 4649

Marketing, 1283, 3805, 3937, 3945, 3974
- Africa, 44
- Brazil, 21
- British India, 3557
- Cote d'ivoire, 3743
- country reports, 21
- Denmark, 3893, 3911
- East Indies, 3557
- factories, 3956
- Ghana, 44
- Indonesia, 3928, 3951
- industry, 3951
- investments, 3743, 3795
- Iran, 3930
- Kilombero valley teak company, 3620
- Netherlands, 3557
- Siam, 3557
- Singapore, 3795
- Taiwan, 3914
- Tanzania, 3620
- Thailand, 1283, 3913, 3956
- timber trade, 3620
- tropical woods, 3930

Martesia fluminalis
Myanmar, 3111
Mating system
genetic variation, 780
Measurements
giant timber, 3546
Mechanical properties, 4155, 4156, 4157, 4158, 4159, 4162, 4168, 4175, 4181, 4189, 4196, 4210, 4217, 4219, 4226, 4227, 4228, 4229, 4234, 4248, 4251, 4257, 4258, 4259, 4263, 4265, 4272, 4273, 4275, 4280, 4281, 4282, 4285, 4288, 4290, 4301
creep, 4167
cross grain, 4286
cutting resistance, 4241
dimensional stabilization, 4174
juvenile wood, 4181
moisture content, 4191
plantation grown teak, 4171, 4228, 4257, 4270, 4290
shrinkage, 4232
site factors, 4275
stress, 4167
stress relaxation, 4155
swelling, 4232
terminology, 4217
thinning materials, 4251
wood anatomy, 4240
working properties, 4162
Mechanical tests
strength properties, 4243
Mechanization
felling, 2516
harvesting, 2519, 2527
isoquant method, 2486
logging, 2486
Medicinal plants
taungya crops, 141
underplanting, 130
understorey, 131, 4744
Medicinal properties, 4725
allelopathy, 617, 622
anti-diarrhea, 612
charcoal, 612
chemical components, 598
roots, 598
teak oil, 4741, 4748
tuberculosis, 4749
Meghalaya
sloping land, 232
Meiji era
species introduction, 1091
Melghat forests
natural regeneration, 1362
Meloidogyne
root knot, 2776
Mensuration, 3559
yield, 3524
Mercury
bark, 4178
Metabolism
crassulacean acid metabolism, 627
Metals
leaves, 570
Metarhizium anisopliae
biological control, 3150
Hyblaea puera, 3150, 3183
Metepa
Hapalia machaeralis, 2829
sterilisation, 2829
Methylanthra quinone
teak oil, 4758
Mexico
economics, 3623
growth, 1995
growth rate, 3623
protection, 2812
provenance trials, 935
Xyleborus morigerus, 2812
Micro fungi
soil fungi, 495
Microbial activities
carbon dioxide evolution, 463
litter decomposition, 463
Microbial control, 3184
Microbial insecticide
Bacillus thuringiensis, 3165
Eutectona machaeralis, 3165
Microbial pathogens
biocontrol, 3132
biological control, 3131
Cossus cadambae, 3163
Hyblaea puera, 3131, 3132
Sahyadrassus malabaricus, 3131, 3132
Microbiology
soil chemistry, 499
Microcerotermes
crops, 3060
Microcerotermes beesoni
termite resistance, 4524, 4525
Microcuttings
vegetative propagation, 1751
Microflora
seed storage, 2850
Micronutrients
nutrient deficiency, 621
seedling growth, 2298
seedlings, 621
Microorganisms
cellulolytic microorganisms, 488
rhizosphere microflora, 505
soil biology, 503
soil nutrients, 398
Micropropagated plantlets
field trials, 2261
Micropropagated shoots
hardening, 1786
rooting, 1786
Micropropagation protocol, 1792
Micropropagation, 1685, 1695, 1698, 1706
adventitious rhizogenesis, 1783
IUFRO, 1758
phenolic exudates, 618
propagation, 1730
random amplified polymorphic DNA markers, 1705
` tissue culture, 1705, 1709, 1730, 1757, 1783
Microtermes
Amitermes evuncifer, 3060
crops, 3060
Microtermes pakistanicus
Pakistan, 2796
Microwave radiation
thermal conductivity, 4220
trunk diameter, 3541
Migration
Eutectona machaeralis, 3006
Hyblaea puera, 2843, 3006, 3017, 3112
Mikania cordata
weed control, 2669
Mikania micrantha

economic impact, 2661
weed control, 2669

Mildew
chemical control, 2740
leaves, 2784
Uncinula tectonae, 2784

Mine restoration
afforestation, 1912
biomass production, 1925
soil properties, 356
stump planting, 1924

Mineral acids
acid resistance, 4521

Mineral concretion
chemical composition, 593

Mineral constituents
wood properties, 4308

Mineral inclusions
chemical properties, 4357

Mineralization
litter decomposition, 414

Minerals
Gangetic alluvium, 1018

Minerology
Madhya Pradesh, 240, 387

Mistletoe, 2627, 2641
Assam, 2654
chemical control, 2632, 2633, 2646, 2647, 2648
host-parasite relationship, 2647
Kerala, 2627, 2647, 4190
loranthaceae, 2626
parasites, 2672
phanerogamic parasite, 2647
phorophyte, 2635
Phthirusa adunea, 2671, 2672
trunk injection, 2632, 2648
weed control, 2666, 2668
weedicide, 2648
weedicides, 2646
weeds, 2652
wood properties, 2631, 2649, 2650, 4190

Mitkyina division
natural regeneration, 1252

Mixed cropping, 2346
agroforestry, 2329, 2346, 2417, 2418, 2419, 2420, 2421
coffee plantations, 2406
country reports, 2133
Diospyros celebica, 2339
groundnut, 2418
Karnataka, 2417, 2418, 2419, 2420, 2421
kumri crops, 2330
plantation establishment, 2133, 2406
plantation trials, 2339
regeneration, 1169
Schleichera oleosa, 2457
soil management, 2336
Sorghum bicolor, 2421
taungya, 2328, 2330, 2335, 2336, 2472

Mixed deciduous forests
site quality, 108
teak forests, 1125

Mixed forests, 2345, 2410
bamboo, 1356
plantation establishment, 1921
plantation techniques, 2411
regeneration, 1353, 1356

Mixed plantations, 1070, 1172, 2165, 2381, 2412
architectural analysis, 2365
Bamanpokri teak plantations, 1859
bamboo, 1237, 1330, 1342, 1966, 2402, 2403, 2404, 2471
Bambusa arundinacea, 2354, 2355
Cassia stamea, 2428
Coffea arabica, 2384
cultivation, 2442, 2445
ecological studies, 2355
economic assessment, 3780
economic evaluation, 2407
fire resistance, 2398
insect outbreak, 2872
Kerala, 197, 2354, 2355
Leucaena glauca, 2476
natural regeneration, 1330
Pyinmana Forest Division, 1330, 2404
regeneration, 1194, 1237, 1342, 1966
Santalum album, 2451
silviculture, 1170, 1172, 1194, 2126
site factors, 96
soil properties, 197, 2126, 2442
soil types, 2381
species composition, 3506
species diversity, 120
succession, 2400
Xylia dolabriformis, 2398

Mixed planting, 2391
afforestation, 2482
antibiotic effect, 2393
Calamus simplicifolius, 2482
Diospyros melanoxylon, 78
eucalypts, 2475
intensive management, 2435
Leucaena glauca, 2446
Ocimum kilimandscharicum, 2393
Pinus, 2480
regeneration, 1257
silviculture, 2444
taungya, 1257
Xylia dolabriformis, 2391

Mizoram, 4246

Modulus of elasticity
plantation grown teak, 4255

Modulus of rupture
plantation grown teak, 4255

Moist deciduous forests
natural regeneration, 1352

Moisture absorption
particle boards, 4673
timber quality, 4160

Moisture conservation
biofertilizers, 2321

Moisture content, 4176, 4188
bending properties, 4260
dimensional stabilization, 4565
fruits, 645
mechanical properties, 4191
microwave radiation, 4220
shrinkage, 4344
strength properties, 4245
swelling anisotropy, 4172
thermal conductivity, 4220
wettability, 4203
wood properties, 4059, 4203, 4230

Moisture distribution, 4025
plantations, 273

Moisture metre, 4225

Molding powder
filler, 4694

Molecular characterization
seed origin, 994

Molecular maps
seed banks, 1029

Mong Mit Forest Division
natural regeneration, 1246

Monkey
habitats, 151

Monoculture plantation
Kerala, 194, 197
nutrient cycling, 406
soil degradation, 231
soil properties, 170, 194, 197, 310, 311

Monohammus rusticator
longicorn borer, 2937

Monsoon
Hyblaea puera, 2843

Morphogenesis, 1697

Morphology, 305, 670, 2582, 2869
abnormalities, 710
bud trace connections, 704
conjointed quadruplet seedling, 708
foliage, 709
leaves, 669, 681, 685, 702, 707, 1007
phyllotaxy, 691
plantation variation, 1034
provenance identification, 1007
seedlings, 668, 708, 710

Mortality
drought, 2562, 2563, 2568
grafting, 1784
Odontotermes distans, 2568
Odontotermes parvidens, 2562
plant density, 2105
soil chemistry, 320
soil properties, 298
thinning, 2561

Moulds
Clypeolella tectonae, 2785
wood preservatives, 4480

Moulting
Eutectona machaeralis, 3055

Mound layering
stumps, 1736

Mozambique
country reports, 26
wood properties, 4014

Mudumalai
mortality, 2105
phytosociology, 129

Mulching
soil aeration, 228

Multimeter
height measurements, 3371

Multinucleate cambial initials
nuclear behaviour, 713

Multipurpose trees
wasteland development, 2380

Multivariate study
genetic variation, 781

Mungod pole forest
Kanara plantations, 1354

Muthodi teak plantation, 3660

Myanmar, 3, 262, 859, 906, 1072, 1182, 1185, 1414, 2108, 2134, 2349, 2350, 2495, 3565, 3600, 3926, 3985, 4168, 4538
agroforestry, 2341, 2351, 2477
air drying, 4538
artificial regeneration, 1250, 1253, 1259, 1314, 1315
assessment, 3674
bamboo, 1378, 1383, 1384, 1389, 2403, 2404, 2471
basic experience, 3729
biological control, 3133
brandis system, 3307
breeding, 907
chemical properties, 4664
country reports, 29, 32
cultivation, 1923
degraded forests, 1898
dibbling, 1528, 1530, 1579
dichloro diphenyl trichloroethane, 4556
dome building, 4634
Duomitus ceramicus, 2837
ecology, 1060, 1063
economics, 3905
elephants, 2555
evergreen forests, 1063
exports, 3882, 4041
felling, 2551
fire protection, 2597, 2598, 2599, 2610, 2611, 2621, 2623, 2624, 2625
floating, 2535
flora, 563
flowered bamboo areas, 1376
forest management, 2349
forest policy, 41
forest types, 1072
genetic improvement, 854, 906
genetic resources, 854
giant timber, 3483, 3484, 3492
girdling, 2495
grading rules, 4610
growth, 1332, 3276, 3419, 3468, 3535, 3545
growth rate, 3267, 3277, 3501
harvesting, 2555
history, 3830
Hyblaea puera, 2846
industry, 3950
insect pests, 2966
inventory, 3250, 3251, 3264
investments, 3596
Kyetpyugan Teak Plantation, 2006
laterite soil, 163
management, 854, 1185, 2108, 3632, 3633
management plan, 3603
marine borers, 2891
Martesia fluminalis, 3111
mechanical properties, 4168, 4226, 4227, 4228
mixed plantations, 1170, 2403, 2404, 2471
mixed planting, 1257
Mong Mit Forest Division, 1246
Myautaung Teak Plantation, 2234
natural regeneration, 1246, 1253, 1259, 1313, 1314, 1315, 1332
ornamental timbers, 4621
Paliga damastesalis, 2846
physical properties, 4226, 4227, 4228
plantation establishment, 1880, 1881
plantation grown teak, 4228, 4238, 4239, 4267
plantation techniques, 2006
plantations, 32, 163, 1265, 2144, 2178, 3773
prices, 3604
production, 3819
protection, 3600
pure teak plantation, 2031
Pyinmana Forest Division, 2404

rafting, 3273
regeneration, 262, 1249, 1257, 1258, 1265, 1319, 1336, 1337, 1376, 1378, 1379, 1383, 1384, 2350, 4395
rehabilitation, 1898
resources, 3784
review, 3830
royalty, 3674
sawmilling, 3950
seed germination, 1413, 1579
seed origin, 859
seed treatment, 1413, 1414
seedling coppice system, 1319
seeds, 907, 1530
shifting cultivation, 2350
silvicultural techniques, 1249
silviculture, 1170, 1182, 1185, 1379, 2108, 2134
site selection, 3535
soil properties, 201, 202, 215, 262
sowing, 1389, 1414, 1528, 1530, 1579
succession, 1060
sustainable management, 3781
sustained yield, 3565
taungya, 1257, 1258, 2351, 2405, 2477
taungya plantations, 1414
taungya system, 2349, 2350
teak forests, 1121, 1129, 1138, 2611, 2623, 2624, 3548, 3631, 3776, 3794, 4395
thinning, 1246, 2029, 2052, 2178
timber connectors, 4298
timber measurements, 3273
timber production, 3271
timber quality, 4041
trade, 3905, 3926, 4005
utilisation, 2134, 4621
vegetative propagation, 1756
veneer, 4610
volume tables, 3274, 3301, 3302, 3313, 3340, 3500, 3545
wood based industries, 3959
wood chemistry, 4556
wood properties, 1923, 3985, 4005, 4238, 4239, 4267
working plans, 2551, 3865
working stress, 4298
Xyleutes ceramica, 2815, 2817, 2819
yield, 3548
yield regulation, 3307, 3403, 3404, 3405, 3565, 3728
yield tables, 3410

Myautaung teak plantation
Myanmar, 2234

Mycelia sterilia, 2774

Mycorrhiza, 479
plantations, 497
seedling growth, 485

Mycorrhizal colonisation
clones, 518

Mycorrhizal symbiosis, 484

Myllocerus subfasciatus
defoliators, 2950

Myllocerus viridanus, 2797
Beauveria bassiana, 3185

Myodwin teak plantations, 1968

N/d curves, 2212

NABARD
investments, 3686

Nail holding properties, 4278, 4396
plywood, 4424

Nallamalais, 3853, 3854

Nasutitermes costalis
termite damage, 3227

National programmes
genetic conservation, 895

Natural durability, 4530
chemical composition, 590
marine borers, 4478

Natural enemies
Brachymeria lasus, 3090
Enterobacter aerogenes, 3090
Eutectona machaeralis, 3090
Hyblaea puera, 3090, 3167, 3179
Palexorista solennis, 3090
Pyrausta machaeralis, 3174

Natural forests, 1391
Kerala, 157
seedlings, 1343
seeds, 1391
Thailand, 77
wildlife habitat, 157

Natural regeneration, 1239, 1246, 1251, 1253, 1259, 1264, 1268, 1280, 1284, 1286, 1287, 1294, 1299, 1300, 1301, 1303, 1310, 1313, 1314, 1315, 1317, 1318, 1321, 1324, 1328, 1332, 1340, 1341, 1347, 1349, 1366, 1370, 1371, 1382, 1937, 1938, 2233
bamboo, 1248, 1316, 1330, 1356
Chittagong hill tracts, 1244
coppicing, 1322, 2233
deccan plateaux, 1352
dying back, 1349
felling, 1273
fires, 1242, 1318
Melghat forests, 1362
Mitkyina division, 1252
mixed forests, 1356
mixed plantations, 1330
moist deciduous forests, 1352
Mong Mit Forest Division, 1246
Pyinmana Forest Division, 1330
rotation, 2149
seeds, 1242
stump planting, 1286
taungya, 2392
teak forests, 1273, 1347, 1364, 1385, 2233
thinning, 1246

Natural reproduction, 1307, 1308

Natural resistance
Amitermes evuncifer, 4475
Coptotermes formosanus, 4473, 4479
Coptotermes heimi, 4466
marine borers, 4518, 4519, 4526
plus trees, 3056
Spodoptera litura, 3056
wood destroying termites, 3068

Natural succession
teak forests, 1143

Natural thinning, 2094

Natural weathering, 4456

Nectarinia asiatica
biological control, 2665

Neem extract
Hyblaea puera, 3203

Nematodes

Aphelenchoides composticola, 587
paralongidorus sali, 515
parasites, 472, 516
root knot, 2985
survey, 472
toxicity, 587

Nemeritis tectonae
parasites, 3139, 3144

Neotermes, 2940

Neotermes tectonae, 2941, 2942, 3077
chemical control, 3207
temperature, 2806
wood quality, 2925, 2926

Nepal
country reports, 20
nursery techniques, 1635
nursery trial, 1879

Nesokia indica, 3102

Netherlands, 244, 3521, 3557, 3943
artificial regeneration, 1938
Calotermes tectonae, 2933
coccids, 2934
dunctiferalis, 2934
cultivation, 1804, 1938
Duomitus ceramicus, 2933
exports, 3943
Government teak plantations, 3772
Hyblaea puera, 2933
increment, 3563
investments, 3629, 3772
marketing, 3557
natural regeneration, 1938
plantation establishment, 1208
soil properties, 244
timber quality, 3629
trade, 3878
utilisation, 3557
Xyleborus destruens, 2933
yield tables, 3521, 3563
Zeuzera coffeae, 2933

Neutron activation analysis
gold content, 4346

New forests
environmental factors, 64
nutrient cycling, 350
rainfall interception, 526

New Guinea
Hyblaea puera, 3104
imports, 3883
plantation establishment, 1208
pollination, 812
teak forests, 3637

New variety, 772

New zealand
elephant habitat, 156
teak forests, 156

Nicaragua
afforestation, 2190
allozyme diversity, 950
Madelena project, 1220

Niche measurement
species diversity, 1160

Nigeria, 57, 88, 473, 910, 935, 955, 968, 992, 1126, 1652, 2147, 2469, 3589
acid tolerance, 992
afforestation, 1858, 2011
agroforestry, 2430, 2468
aluminium tolerance, 992
arbovirus vectors, 57
biomass, 2180, 3451, 3452
breeding, 807, 931
butt rots, 2758
Cassia stamea, 2428
chemical composition, 566
clones, 992
crown, 4137
dris evaluation, 88
economic assessment, 3960
ecosystems, 307
Enugu pitwood plantations, 3764
erosion, 67
fertilizers, 2291
fomes lignosus, 2758
forest fires, 2616
forest types, 57
fuelwood, 1857, 4726
genetic improvement, 987
genetic variation, 739, 955
genetics, 807
growth rate, 3359, 4256
growth, 53, 3543
growth rings, 4078
heritability, 807
heterotrophic nitrification, 502
humic acid, 2281
hydrology, 537
intercropping, 2468, 2469
leaf abscission, 695
leaves, 2799
Lixus camerunus, 2883
management, 2015, 2024, 3589, 3597
mechanical properties, 4196
mixed plantations, 2428
monoculture plantation, 310, 311
Nimbia Timber Plantation Project, 2015
nitrogen cycling, 307
nursery techniques, 1633
nutrient contents, 2180
nutrient requirements, 2310
nutrient status, 695
nutrient uptake, 2281
nutrients, 310
pattern analysis, 1204
phloem, 4121
plantation establishment, 1811, 3698
plantation grown teak, 4057, 4137, 4256
plantation raising, 1189
plantation schemes, 1905
plantation techniques, 2024
plantations, 67, 84, 1127, 2291, 2639, 3737
planting stock, 1633, 2258
plus trees, 955
pollen, 814
pollinators, 813
processing, 4644
productivity, 169, 3451, 3482
provenance trials, 881, 882, 883, 910, 935, 955, 968, 989
rainfall, 53, 67
regeneration, 1281, 2099, 2249
replanting, 167
root penetration, 308
root rot, 2752, 2753, 2754, 2758
roots, 695
sampling, 3253
seasonal variation, 4121
seed oils, 566
seed orchards, 931
seeding habits, 1281
seedling growth, 1652, 2281
seeds, 1281
silvicultural characteristics, 1204

silviculture, 1116, 2099, 2249
site index, 84, 3281
site quality, 88
smallholder participation, 2430
soil chemistry, 502
soil fertility, 167, 473
soil mites, 473
soil nutrients, 88, 166
soil properties, 166, 169, 245, 269, 308, 310, 311, 1127
spacing, 1652, 2179, 2180
species introduction, 1116, 1126
stand curve analysis, 1204
stomatal conductance, 684
stomatal response, 716
teak forests, 3733
thinning, 2000, 2145, 2147, 2174
timber quality, 2179
TIV plantations, 2024
utilisation, 4644
viability, 814
volume age relationship, 3283
volume tables, 3381
water use, 537
weed control, 2629
weeds, 2639
wood anatomy, 4078, 4137
wood properties, 3990, 4057, 4256
yield tables, 3281
yield, 88, 1116, 2179, 3283
Zonocerus variegatus, 2799

Nilambur, 3848
growth, 3505, 3526
laterite soil, 235
management, 3848
morphology, 2582
phenology, 3526
silviculture, 1180
soil properties, 162
spacing, 2254
stump planting, 2218
thinning, 1981
working plan, 3815
yield tables, 3505

Nilambur Forest Division
working plan, 3855

Nilambur plantations, 3748, 4779
environmental impact, 1375
fertilization, 2266
history, 2137
productivity, 3418
regeneration, 3837
soil deterioration, 216
spacing, 2254
statistics, 3672
thinning, 1983, 2003, 2112, 2253
underplanting, 2409
working plan, 3771, 3855
yield, 3418
yield tables, 3305

Nimbia timber plantation project
Nigeria, 2015

Nitrification
litter, 411

Nitrogen balances
decay, 4550

Nitrogen cycling
ecosystems, 307

Nitrogen, 192, 441
leaves, 584
organic carbon, 184, 191
rotation, 192
seasonal variation, 441
site quality, 342

Noctuidae, 3069

North America
bibliography, 3713
management, 3713

North East India
genetic improvement, 1020

North Kradenan Forest Division
fire protection, 2622

North Pegu Forest Division
regeneration, 1334

Notching
seed germination, 1562, 1595

NPK fertilizers, 1666, 2290, 2322
cattle manure, 2269
oil cakes, 2320
seedlings, 2269
yield, 2271

Nuclear behaviour
multinucleate cambial initials, 713

Nuclear polyhedrosis virus
Amsacta albistriga, 3181
biological control, 3172
Helicoverpa armigera, 3181
Hyblaea puera, 3092, 3130, 3169, 3172, 3181, 3182
Spodoptera litura, 3181

Nurse crops, 135

Nurseries, 1641, 1642, 1654, 1657
anomala, 3213
azotobacter inoculation, 504
diseases, 2712, 2749, 2750, 2775, 2780
fertilizers, 504, 1670, 2282
fungi, 2723
Helicobasidium compactum, 2728, 2729
Holotrichia insularis, 3224
insect pests, 3113
insecticides, 3213
Kerala, 2698, 2749, 2750, 2775
leaf spot diseases, 2698
Maharashtra, 1657
meloidogyne, 2776
nematodes, 2985
nutrient deficiency, 1613
nutrients, 2325
Papua and New Guinea, 1613
planting stock, 1627
production costs, 1654
root knot, 2776, 2985
root rot, 2728, 2729
root trainers, 2749
rust, 2739
seedling diseases, 2735
seedling quality, 1660
seedlings, 504, 1642, 1654, 1670
soil fertility, 2325
soil insecticides, 3212
soil mixtures, 1660
Sri Lanka, 2888
stump production, 1627, 1628
Tamil Nadu, 1628
Thailand, 2735
vam fungi, 504
white grub, 3114

Nursery beds
planting stock, 1639

Nursery diseases, 2747

Nursery management
Forest Development Corporation, 1659

Nursery period
seedlings, 1649

Nursery practices, 1640
guidelines, 1623
planting stock, 1622
root trainers, 1637

Teak Improvement Centre, 1616
weeding, 2043
Nursery stock
plantation establishment, 915
Nursery techniques, 1611, 1635
afforestation, 1619
planting stock, 1633
seedling production, 1612
silviculture, 1619, 2014
sowing, 1612
Nursery trial
Nepal, 1879
Nutrient analysis
leaf sampling, 597
Nutrient concentration
leaves, 3525
litter, 459
tree volume, 3525
Nutrient conservation
biochemical cycling, 439
Nutrient contents
alluvial soils, 592
clonal resistance, 4507
fertilizers, 2309
foliar analysis, 596
leaves, 592
potassium, 2309
spacing, 2180, 2181
Spodoptera litura, 4507
Nutrient cycling, 350, 435
biomass production, 417
monoculture plantation, 406
Nutrient deficiency
chlorophyll, 572
fuelwood, 632
leaf analysis, 631
nurseries, 1613
oxygen requirement, 392
photosynthesis, 572
sand culture, 586
seedlings, 285, 585, 621, 2294
Nutrient distribution
biomass, 3444, 3503
Nutrient dynamics
reproduction, 644
Nutrient management
fertigation, 2307
sustained yield, 2301
Nutrient release
heat, 288
Nutrient requirements, 2310
fertilizers, 2275
growth, 3450
Nutrient return
litter decomposition, 418, 436
litter, 413, 421, 422, 432, 451, 458
Nutrient status
leaf abscission, 695
roots, 695
Nutrient tests
chemical analysis, 625
Nutrient uptake
seedlings, 1614, 2281
site factors, 3582
Nutrients, 198, 240, 241, 248, 274, 286, 303, 310, 346, 350, 370, 371, 376, 401, 403, 416, 418, 438, 464, 466, 604, 634, 2487
ash, 591
biomass production, 3442
biomass, 3442, 375
carbon, 361
chemical composition, 468
chemical properties, 614
chemistry, 582
deficiency, 306, 404
ecological impact, 427
fertilizers, 2290
foliage, 582
foliar composition, 614
gibberellic acid, 1651
harvesting, 375, 2487
laterite soil, 198, 371
leaves, 425, 591, 600
litter decomposition, 405, 418, 425, 438, 464, 468, 600
litterfall, 416, 466, 469
Mae huad teak plantation, 346
monoculture plantation, 310
NPK fertilizers, 2290
nurseries, 2325
organic matter, 286, 416
plantations, 203
seedlings, 604, 1651
soil chemistry, 241, 303, 361, 370, 404
soil fertility, 2325
soil organic matter, 470
soil properties, 198, 203, 240, 248, 274, 310, 346, 401, 403, 427
Nutrition
fertilizers, 2161
Glomus fasciculata, 483
Glomus mosseae, 483
vesicular arbuscular mycorrhizae, 483
Nutritive value
leaves, 408, 588, 589
silage, 408
Nyasaland
armillaria root disease, 2718
Ocimum kilimandscharicum
antibiotic effect, 2393
mixed planting, 2393
Octotoma scabripennis
weed control, 2911
Odontaleyrodes splendens
Kerala, 2878
Odontotermes distans
mortality, 2568
Odontotermes parvidens, 2562, 3049
Odontotermes redemanni
Madhya Pradesh, 3049
Oiketicus, 2959
Oil borne preservative
pressure treatment, 4547
Oil cakes
NPK fertilizers, 2320
Oil seeds
intercropping, 2413
Old wood
wood properties, 4042
Oleoresins
teak oil, 4316
Oligosita, 2997
Olivea tectonae, 2755, 2777, 2783, 2794, 4489
Optical properties
veneer, 4671
wood colour, 4237
Organic acids
chemical properties, 4361
Organic carbon
soil properties, 184, 191
Organic matter
litter, 416
nutrients, 286, 416

site quality, 342
soil microorganisms, 452
soil properties, 342, 452

Orientation
seed germination, 1399

Origin
teak forests, 778

Orissa, 558, 1015, 1739
degraded forests, 1369
genetic variation, 800, 1015, 1016
heritability, 801, 1016
litter decomposition, 433
mixed plantations, 1342
plant diversity, 148
plantations, 433
plus trees, 801
prices, 3756
progeny testing, 800, 1015, 1016
regeneration, 1342
soil organic matter, 474
transplanting, 1806
vegetational analysis, 1369

Ornamental timbers
utilisation, 4621

Outcrossing rate
pollination, 818

Oven method
seed germination, 1421

Oxalic acid
bark, 4306

Oxidative activation
flame treatment, 4552

Oxygen requirement
nutrient deficiency, 392

Pagyda salvalis
fruit borer, 3073

Painting, 4415

Pakistan, 1305, 2862, 3127
exotics, 1095
insect pests, 2861, 3127
Irpex flavus, 2737
management, 1185, 3650
Microtermes pakistanicus, 2796
plantation species, 2005
regeneration, 1305
silviculture, 1175, 1185, 1305
termites, 2862
wood destroying fungi, 2737

Palexorista solennis, 3090
biological control, 3193
Hyblaea puera, 3090, 3193
natural enemies, 3090

Paliga damastesalis
biological control, 3147, 3148
Hyblaea puera, 2846, 2867, 2923
Malaysia, 2867, 2922
Myanmar, 2846

Paliga machoeralis
clonal resistance, 4484

Panama, 158
afforestation, 1998
agroforestry, 2388, 2461
cultivation, 1331
line planting, 1946
Madelena project, 1222
plantation establishment, 1916, 1946
seed treatment, 1546
silviculture, 1222
weeds, 1916

Panel, 4700
adhesion techniques, 4714

Paper making, 2184

Papua and New Guinea, 935, 3976, 4319
birds, 150
breeding, 805, 812, 912
chemical properties, 4319
durability, 4186
flowering, 805
genetic improvement, 812, 867, 877, 912, 1339
Hyblaea puera, 2881
kiln drying, 4570
lumber processing, 4185
management, 1948
nutrient deficiency, 1613
particle boards, 4670
plantations, 1149
plywood, 4670
properties, 3975, 3976
provenance trials, 935
reforestation, 1892, 1948
regeneration, 1243, 1339, 1368
silviculture, 1339, 1368, 1386
utilisation, 3975
wood properties, 4186
yield, 1149, 3393

Paralongidorus Sali, 515

Parambikulam wildlife sanctuary
wildlife damage, 2684

Parasites, 2692
biological control, 3137, 3138, 3139, 3158
Brachymeria euploeae, 3195
Carcelia kockiana, 3195
chemical control, 2645
Dendrophthoe falcata, 2645
Echthromorpha notularia, 3195
Eutectona machaeralis, 3188
Hapalia machaeralis, 3137, 3138, 3145
Hyblaea puera, 3137, 3138, 3145, 3158, 3187, 3194, 3195
Lygropia quaternalis, 3137
mistletoe, 2672
nematodes, 472, 516
Nemeritis tectonae, 3139, 3144
Phthirusa adunea, 2672
Sympiesis hyblaeae, 3194
undergrowth, 2897
Xyleborus morigerus, 3153
Xyleutes ceramica, 3139, 3144

Parasitoids
biological control, 3189, 3193
Hyblaea puera, 3167, 3189, 3192, 3193
natural enemies, 3167
Palexorista solennis, 3193
Sympiesis hyblaeae, 3192, 3193

Particle boards, 4632, 4691
leaves, 4740
moisture absorption, 4673
plywood, 4670
properties, 4632, 4662
swelling properties, 4673
wood properties, 4665

Patch mortality
root rot, 2738

Pathology, 2704

Pattern analysis
stand curve analysis, 1204

Pavonia odorata
understorey, 3160

Pavonia zeylanica
understorey, 3160

Peeling characteristics
veneer, 4684, 4686

Pelleting
sawdust, 4557

Penicillium
fungi, 454

Kerala, 454
Peninsular Malaysia, 302
Peniophora
root rot, 2695
Peniophora rhizomorpho-sulphur
root rot, 2696
Perlis
bibliography, 247
laterite soil, 304
soil properties, 247
Permeability
wood properties, 4043
Perum perhutani
Indonesia, 1044, 4778, 4781
Pest resistance
Hyblaea puera, 4494
Pesticide
extractives, 4347
Phanerogamic parasite
host-parasite relationship, 2647
mistletoe, 2647
Phassus, 2832
Phassus borers, 2899
Phenolic compounds
leaves, 2734
Phenolic exudates
micropropagation, 618
Phenological behaviour
leaves, 693
Phenology, 671, 676, 3526
Phenotypes
growth, 653
photosynthesis, 653
water stress, 653
Pheromone-baited trap catches
Prostephanus truncatus, 3022
Philippines, 3
afforestation, 1845
antimutagens, 623
breeding, 741
degraded forests, 1932
fertilizers, 2299
flowering, 741
growth, 1934
interplanting, 2379
litter decompositon, 415
mechanical properties, 4281, 4290
medicinal properties, 4749
plantation establishment, 1818
plantation grown teak, 4290
plantation raising, 1934
pollination, 741
reforestation, 1933, 2299
species trials, 1932
wood properties, 4290
yield prediction, 3466
Phloem production, 4144
Phloem rays
sieve elements, 698
Phloem
seasonal variation, 4121
Phoma leveillei
decomposing fungi, 449
leaf litter, 449
Phomopsis
canker, 2779
leaf hopper, 2828
Phomopsis tectonae
leaf spot disease, 2786
Phorophyte
mistletoe, 2635
Phosphatase test
chemical analysis, 625
Phosphorus
alluvial soils, 2324
fertilizers, 2324
Phostoxine
chemical control, 3207
Neotermes tectonae, 3207
Photo interpretation, 3257, 3258
Photosynthesis, 1819
chlorophyll, 572
leaf gas exchange, 652
leaf position, 652
nutrient deficiency, 572
phenotypes, 653
transpiration, 540
water stress, 540, 653
water use efficiency, 646
Phthirusa adunea
mistletoe, 2671, 2672
Phyllotaxy, 677
cotyledon number, 664
leaves, 711
morphology, 691
Physical properties, 4077, 4155, 4156, 4157, 4158, 4159, 4162, 4175, 4189, 4217, 4226, 4227, 4251, 4258, 4259, 4280, 4282, 4285, 4288, 4296, 4301
juvenile wood, 4181
plantation grown teak, 4228, 4257
sapwood heartwood relationship, 4079
site factors, 4275
thinning materials, 4251
working properties, 4162
Physiological assessment
seed treatment, 1518
Physiology, 634, 2770
growth, 719
leaf growth pattern, 649
leaves, 647, 2770
photosynthesis, 1819
teak forests, 1132
water use efficiency, 647
Phytoalexins
fungal diseases, 2688
Phytochemistry
bark, 576
review, 595
Phytomass
stand composition, 3504
Phytophagous insects
clonal variation, 3047
Phytoseius silvaticus, 3123
Phytosociology, 129, 1092, 1162, 1163
biomass, 1075
Pink disease
Fusarium solani, 2727
stem canker, 2727
Pinus
mixed planting, 2480
Pipe model theory
foliage, 3430
sapwood, 3430
Plagiohammus spinipennis
weed control, 2651
Planning
plantation grown teak, 2152
Plant density
age, 290
mortality, 2105
soil nutrients, 290
Plant diversity
Madhya Pradesh, 1159

Orissa, 148

Plant extracts
allelopathic effects, 1577
antifeedant property, 3211
Eutectona machaeralis, 3209, 3211
Hyptis suaviolens, 1577
seed germination, 1577

Plant invasions
Western ghats, 118

Plantation establishment, 2239, 3155
afforestation, 1853, 1869, 1871, 1959
Argentina, 1809
Bangladesh, 1956
biological control, 3155
Brazil, 1107, 1108, 1825, 2406
coffee plantations, 2406
Costa Rica, 1869, 1900, 1946
country reports, 2133
cultivation, 1809, 1900, 1928, 1964
environmental impact, 75
fertilisers, 2241
genetic improvement, 915
Ghana, 106
group planting system, 1908
growth performance, 915
growth, 2239
Indonesia, 1846, 1871, 1941
investments, 3720
Ivory coast, 1109, 1887, 1953, 2160
Java, 1877
Kerala, 3760
Laos, 95
line planting, 1946
Maharashtra, 3720
Malaya, 1961
Malaysia, 1868, 1874, 1874, 1883, 1936, 1964, 2133
management, 1915, 2239
mixed cropping, 2133, 2406
mixed forests, 1921
Myanmar, 1880, 1881
Netherlands, 1208
New Guinea, 1208
Nigeria, 1811, 3698
Panama, 1916, 1946
Philippines, 1818
planting stock, 892, 915, 1953, 1958, 1961
productivity, 1900
provenance trials, 934
regeneration, 1931
research, 2239
Saccharum spontaneum, 1916
savanna, 2160
seed germination, 1826, 2239
seed origin, 1941
seed treatment, 2239
seminar proceedings, 1964
Sidajoe, 3635
silviculture, 1825, 1887, 1952, 1961, 2239
social forestry, 1868
soil properties, 95, 106
Solomon islands, 1958, 1959
species introduction, 1107, 1108, 1109, 2160
stump size, 1958
sustainable production, 3760
Tanzania, 75
Thailand, 2050, 2239, 3155
Trinidad, 1266, 1931
Tumpangsari method, 1877
Venezuela, 1928
weeds, 1916

Plantation evaluation
seed orchards, 3413

Plantation forestry
India, 2130
Sri Lanka, 2130

Plantation grown teak
Africa, 1184
age, 4112, 4209
Australia, 4096
breast height, 3570
Cote d'ivoire, 1184
crown, 4137
decay resistance, 4462
density variation, 4209
durability, 4449
fluting, 3570
furrows, 3569, 3570
Ghana, 4053
growth rate, 4256
heartwood proportion, 4112
height measurements, 3371
juvenile wood, 4053, 4462
Kerala, 4084, 4088
Malaysia, 4209, 4611
mechanical properties, 4171, 4228, 4257, 4270, 4290
modulus of elasticity, 4255
modulus of rupture, 4255
multimeter, 3371
Myanmar, 4228, 4238, 4239, 4267
natural forests, 1391
Nigeria, 4057, 4137, 4256
Philippines, 4290
physical properties, 4228, 4257
relascope, 3371
seeds, 1391
shaping, 2152
silviculture, 1184
stem volume, 3336
strength properties, 4148, 4254
Tanzania, 4171
Thailand, 4287
thinning, 2152
timber quality, 4047, 4080, 4084, 4088, 4182, 4611
volume tables, 3574
wood anatomy, 4137
wood defects, 4577
wood properties, 4019, 4057, 4060, 4096, 4238, 4239, 4256, 4267, 4287, 4290, 4577
yield tables, 3346

Plantation management
Australia, 2204

Plantation raising
Andamans, 1939
Bamonpokri teak plantations, 2004
deciduous forests, 1939
growth, 1934
Java, 2172
Maharashtra, 1636
Malaya, 1962
Nigeria, 1189
Philippines, 1934
root trainers, 1636
seed origin, 1927
silviculture, 1927, 1962
site factors, 2004
Sri Lanka, 1927
stump planting, 1636
Tamil Nadu, 1889
Trinidad, 1052, 2025

Plantation schemes
Gujarat, 3751
investments, 3751
Nigeria, 1905
Tamil Nadu, 3751

Plantation species, 2005

Plantation techniques
Africa, 2063
artificial regeneration, 2075
Bengal, 1630
Cuba, 2159
cultivation, 1918
diseases, 2101
fertilizers, 2161
fire protection, 2243
Gujarat, 1918
Java, 2007
Jivrajbhal patel agroforestry, 1918
Kyetpyugan teak plantation, 2006
Madhya Pradesh, 2196
Maharashtra, 1657
management, 2024, 2131, 2159, 2187
mixed forests, 2411
Myanmar, 2006
n/d curves, 2212
Nigeria, 2024
nurseries, 1657
nutrition, 2161
pure teak plantation, 2142
review, 2090
silviculture, 2063
single stem silviculture, 2212
spacing, 2007
Tamil Nadu, 2217
Thailand, 2111, 2228
thinning, 2212
timber production, 2111
TIV plantations, 2024
Zaire, 2187

Plantation trials
coal mine areas, 1884
Diospyros celebica, 2339
Egypt, 2676
gibberellic acid, 1781
Indonesia, 1113, 2339
Java, 2339
malabar teak, 1113
mixed cropping, 2339
plantation trials, 2339
reclamation, 1884
root damage, 2676

Plantation variation
Venezuela, 1034

Plantations
Africa, 242, 1333, 1999, 3230, 3741
age, 103
America, 1995, 2079
Andamans, 1186, 1950
Andhra Pradesh, 225, 2237
artificial regeneration, 1270
Assam, 514, 1186
bamboo, 2373
Bangladesh, 265
Bengal, 253, 2082
Benin, 242, 1999
Bihar, 1186
branching, 696, 962, 2069
Brazil, 21, 1919
Burma, 1980, 3695
burning, 2053
carbon, 188, 192
clear felling, 2504
Coorg, 962, 3774
Costa Rica, 1922, 2170
country reports, 21, 25, 32, 43
cover crops, 2394
cultivation, 1803
damage, 2677
decomposition, 430
deer menace, 2674
degraded land, 393
Dehra Dun, 2394
density reduction, 2079
diseases, 2773, 2775
distribution, 1119
economic impact, 2661
economics, 3730, 3745, 3758
elephant damage, 2677
elephants, 2682
erosion, 67
evergreen forests, 253
farm forestry, 2408
fertilizers, 270, 2270, 2291, 2297, 2317
forest policy, 1920
France, 1119, 2408
genetic improvement, 872
Ghana, 175, 176
grass, 112
ground flora, 119, 140
growth modelling, 3372
growth, 1227, 1995, 2110, 2452
habitat use, 2682
hare attack, 2685
height, 103
history, 2137
hormones, 2110
humidity, 66
hydrology, 526
increment, 2030
India, 270, 352, 1134, 2137, 2636, 2773, 3605
Indonesia, 2026, 2803
infiltration capacity, 329
insect pests, 3020
interplanting, 2454
investments, 3730
Java, 1803
Karnataka, 93, 332, 333, 334, 1270
Kerala, 157, 180, 182, 186, 187, 188, 192, 195, 196, 197, 2661, 2775, 3020, 3605, 3704, 3745, 3758
laterite soil, 163, 164
laterization, 253, 261
Latin America, 3231
leaf litter, 430
leucaena, 117
liberia, 242
litter decomposition, 433, 434, 440
loam soils, 273
loranthus, 2640
Madhya Pradesh, 119, 224, 490
Maharashtra, 69, 1270, 2109, 2297, 2373
Malaysia, 1227
mammals, 153
man made forests, 258
management, 1999, 2047, 3605
marketing, 21
mexico, 1995
mikania micrantha, 2661
mixed plantations, 197
moisture distribution, 273
monoculture plantation, 197
Myanmar, 32, 163, 1265, 2144, 2178, 3773
mycorrhiza, 497
natural forests, 77, 157
new forest, 526
Nigeria, 67, 84, 1127, 2291, 2639, 3737
Nilambur plantations, 2137
nitrogen, 184, 192
nurseries, 2775
nutrients, 203
organic carbon, 184
Orissa, 433
Papua and New Guinea, 1149

planting methods, 2071
podzolization, 253
productivity, 11, 119, 872, 3347, 3605
provenance trials, 911
pruning, 2069
Puerto Rico, 1863
quality control, 2170
quality timber, 2047
rainfall, 67, 526
rat attack, 2685
regeneration, 1198, 1202, 1265, 2082
research, 2245
resource economics, 3704
rooting, 2110
rotation, 192, 2021
seed orchards, 265
seed origin, 962
seminar proceedings, 3347
Senegal, 1333, 3741
shelterbelt, 2452
silviculture, 11, 1119, 1202, 2047, 2082, 2109, 3741
site index, 84
site quality, 93, 103, 3347
soil chemistry, 187, 188, 192
soil compaction, 329
soil fertility, 225, 270, 352, 1333
soil loss, 544
soil mapping, 293
soil moisture, 229, 230, 317
soil nutrients, 196, 242, 334
soil properties, 175, 176, 180, 182, 184, 186, 195, 197, 203, 224, 225, 242, 253, 258, 261, 265, 273, 332, 333, 338, 352, 380, 393, 1127
spacing, 1970, 2030
species diversity, 69, 119, 142, 1134
species trials, 1267, 1919
Sri Lanka, 68, 911, 1920, 1967, 2183, 3828
stump planting, 2069
succession, 140
Sudan, 1224
Tamil Nadu, 225, 270, 2636
Tanzania, 153
taungya, 2481
teak forests, 1134, 2053
technology, 3347
temperature, 66, 77
Thailand, 77, 317, 1202, 2228
thinning, 2026, 2128, 2129, 2176, 2178, 2215, 2222, 2223, 2228, 2245, 2248
Togoland, 1977
trenching, 534
Trinidad and Tobago, 3644
Trinidad, 39, 142, 1261, 2154
underplanting, 117
understorey, 112, 139
Uttar pradesh, 229, 1186
vam fungi, 490
Venezuela, 293
Vesicular arbuscular mycorrhizae, 514
Vietnam, 43, 1101
volume tables, 2021, 3828
water loss, 544
weeds, 1980, 2071, 2636, 2639, 2640
West Bengal, 329, 1186, 2208
West Indies, 1995
wildlife habitat, 153, 157, 352, 2677
World, 11, 25
Xyleborus destruens, 2803
yield regulation, 3279
yield tables, 1261, 3572
yield, 293, 1149, 1186, 1333, 2026, 3571, 3741

Planting area
slash burning, 1976, 2104

Planting costs, 3734

Planting density
irrigated stands, 3436

Planting evaluation, 3688

Planting methods
growth, 2153
weeding, 2071

Planting programme, 1945

Planting season
premonsoon planting, 2219
stump planting, 2087

Planting sites
clones, 856
growth, 857

Planting stock
artificial regeneration, 1618
bud grafting, 1788
budding, 1716
clonal propagation, 1754, 1770
clones, 1754
culling, 1665
dona leaf cups, 1606
growing media, 1661
growth substances, 1789
India, 1638
Indonesia, 1699
Ivory Coast, 1953
longitudinal splitting, 1605
Maharashtra, 1638, 1665
Malaya, 1961
Malaysia, 1754
Nigeria, 1633, 2258
nurseries, 1627
nursery beds, 1639
nursery techniques, 1622, 1633
plantation establishment, 892, 1953, 1958, 1961
planting, 1638
regeneration, 1618
root trainers, 1638
rooted cuttings, 1766
seed orchards, 1716
seed quantity, 1593
seeding density, 1412
seedling growth, 1661, 1665, 1789
shoot cuttings, 1766
silviculture, 1961
Solomon Islands, 1958
split stumps, 1606
Sri Lanka, 1622
storage, 1644
stump planting, 1608, 1618, 2085, 2086
stump production, 1627
stump size, 1958
stump storage, 1699, 2033
stumps, 1593, 1605, 1639, 1684
survival, 1644
Tamil Nadu, 1789
Thailand, 1699, 1788, 2033
tissue culture, 1801
vegetative propagation, 1716

Planting stumps
storage technique, 1610

Plastic boards
swelling pressure, 4704

Plastid ultrastructure
cambium, 4106

Ploughing
afforestation, 1955
Plus trees
Andhra Pradesh, 954
China, 955
cloning, 1701
DNA markers, 1041
field trials, 2262
genetic improvement, 923, 954
genetic variation, 955
grafting, 995, 1621
heritability, 801
India, 955, 1024
Kerala, 1033
Maharashtra, 958, 2262
natural resistance, 3056
Nigeria, 955
Orissa, 801
progeny testing, 1024
provenance trials, 955, 1024
random amplified polymorphic DNA markers, 1041
RAPD, 1041
seed germination, 1520
seed orchards, 954, 958, 995
spodoptera litura, 3056
Tamil Nadu, 1024
teak improvement, 1024
Thailand, 955
tissue culture, 1024, 1701
tissue cultured plants, 2262
Uttar Pradesh, 1033
vegetative propagation, 958, 995, 1621
West Bengal, 1701
wood properties, 4515
Polyporus versicolor
decay resistance, 4532
Plywood
air craft, 4677
decorative plywood, 4679
India, 4668
Madhya Pradesh, 4712
nail holding properties, 4424
Papua and New Guinea, 4670
particle boards, 4670
pulping, 4729
South Africa, 4661
veneer waste, 4729
veneer, 4661, 4701, 4702
veneering industry, 4712
wood properties, 4424
Podospora nannopodalis, 2782
Podzolization
Amazon, 3291
Bengal, 253
Brazil, 3291
evergreen forests, 253
plantations, 253
Poles
electric transmission, 4633
harvesting, 2519
rotation, 3485
utilisation, 4625
Policy
Cuba, 4773
fast grown timber, 3998
Pollen
anthesis, 808
crown directions, 1433
fungi, 2722
pollination, 808, 828
seed germination, 1433, 1683
seed orchards, 1433
seed production, 828
seeds, 2722
tissue culture, 1683
viability, 814, 828
Pollination
anthesis, 808
breeding, 741, 742, 812
clones, 822
floral biology, 826, 827
flowering, 741, 811, 820, 823
flowers, 2913
foraging dynamics, 829
fruit production, 817, 823, 826
genetic improvement, 812, 996
insect visitors, 819
insects, 820, 2913
isoenzymes, 818
Kerala, 817, 819, 820
Maharashtra, 824
New Guinea, 812
outcrossing rate, 818
Papua and New Guinea, 812
Philippines, 741
pollen, 808, 828
progeny trials, 996
seed orchards, 822
seed production, 828
species diversity, 809
Tanzania, 996
Thailand, 816, 818, 825, 826, 827, 828
viability, 828
West Bengal, 808
Western Ghats, 829
Pollinators, 813, 821
Polybag size
seedling growth, 1646
Polyembryony, 663
Polyphenol
clonal resistance, 4484
foliar protein, 4484
Polyporus, 2736
Polyporus versicolor
decay resistance, 4533
decay test, 2788
Polyporus zonalis
decay, 2778
root rot, 2695, 2696
Polystictus steinhellanus
wood destroying fungi, 2699
Polystictus versicolor
decay resistance, 4498
Polyvinyl acetate
adhesives, 4417
Ponorogo
fencing, 4658
Pontanus puerilis
biological control, 3157
Population dynamics
defoliators, 3016
Eutectona machaeralis, 2871, 2964, 3016
Hyblaea puera, 2825, 2871, 2964, 2999, 3016, 3059
Pyrausta machaeralis, 3028
Poria monticola
decay resistance, 4532, 4533
decay test, 2788
extractives, 4533
Potassium
fertilizers, 2295, 2300, 2309
review, 2295
soil chemistry, 250
soil properties, 233
Potassium nitrate
seed germination, 1512
Potting media
seedling growth, 1609, 1672
Powdery mildew infection

leaves, 2734

Power transformers, 4642

Pratapgarh teak forests
birding, 159

Predators
Anoplolepis longipes, 3196
Anthia sexguttata, 3166
ants, 3196
crematogaster, 3196
Hyblaea puera, 3159, 3166, 3167
natural enemies, 3167
parasitoids, 3167
Xyleutes ceramica, 3196

Premonsoon planting
planting period, 2219

Preservative treatment, 4539
boucherie process, 4555
durability, 4502
housing, 4540
thinned wood, 4540

Presowing treatments
seed germination, 1424, 1469

Pressure treatment
oil borne preservative, 4547
wood preservatives, 4554

Price-age gradient
rotation, 2201

Prices
Bangladesh, 3931
Burma, 3881
demand and supply, 3917
fuelwood, 3886
imports, 3885
India, 3881
investments, 3680
Karnataka, 3932
Kerala, 3915, 3917, 3918, 3919, 3920, 3921
Madhya Pradesh, 3886, 3935, 3936
Maharashtra, 3680, 3886
Myanmar, 3604
Orissa, 3756
private companies, 3680
timber trade, 3885
trade, 3903
yield, 3680

Private companies
investments, 3680

Private forestry
Thailand, 1873

Processing
Africa, 44
Ghana, 44
logs, 4393
marketing, 44
Nigeria, 4644
value added products, 4728

Prodan's method
stand tables, 3338

Prodenia litura
food plants, 2831

Production
India, 3820
Indonesia, 3818
Java, 1960
Myanmar, 3819
sustainable agriculture, 2360
Trinidad and Tobago, 2360

Production costs
seedlings, 1654

Production economics
railways, 4652

Productivity, 169, 394, 498, 1760, 1798, 2227, 3284, 3347, 3487, 3499
agroforestry, 2352
agrosilvopastoral systems, 2422
Bangladesh, 3364
Belgium, 3676
Bengal, 3349
biomass, 3451
biomass estimation, 3443, 3474
China, 3379
Costa Rica, 1900, 3325
density, 3705
economic analysis, 2027
economics, 3606, 3833
energetics, 3502
fertigation, 2305
genetic improvement, 872
Ghana, 3449
ground flora, 119
Gujarat, 3458
India, 1131, 3605
Indonesia, 3330, 3331, 3474, 3509
intensive management, 3330
investments, 3523, 3606, 3796
irrigated plantations, 2289
irrigation, 2305
Karnataka, 2305, 2422, 3402
Kerala, 394, 498, 3377, 3487, 3605, 3796, 3833, 3849
Madhya Pradesh, 119, 3383
Maharashtra, 3499
Malaysia, 3395
management, 3605, 3676, 3705, 3849
Nigeria, 169, 3451, 3482
Nilambur plantations, 3418
plantations, 11, 119, 872, 3347, 3605
root biomass, 3530, 3531
rotation, 2027, 3487, 3705
seminar proceedings, 3347
silviculture, 11, 3437, 3796
site factors, 3659
site index, 3417
site quality, 3491, 3523
site technology, 3347, 3395
Southeast Asia, 3659
Sri Lanka, 3561
Tamil Nadu, 2289, 2352
Tanzania, 2227, 3417
teak forests, 1131
Thailand, 3389, 3394, 3467
thinning, 1993, 2186, 2227
Uttar Pradesh, 3443
World, 11
yield, 3418, 3552
yield tables, 3491

Profitability
Bangladesh, 3765
costa rica, 3599

Progeny testing
clones, 761, 959
genetic parameters, 925
genetic variation, 800, 1015, 1016
grafting, 806
India, 1024
Maharashtra, 761, 959, 1015
Orissa, 800, 1015, 1016
plus trees, 1024
provenance trials, 1024
Tamil Nadu, 1024
Tanzania, 806
teak improvement, 1024
Thailand, 1026

Progeny trials
Andhra Pradesh, 46
Malaya, 1045
Tanzania, 996, 1032

Propagation
Africa, 44, 1745, 1746

cuttings, 1744
Ghana, 44
in vitro culture, 1752
Malaysia, 1752
micropropagation, 1730
Thailand, 740, 1715
tissue culture, 1730

Propagule production
tissue culture, 1725

Properties, 47, 3974, 3976, 4004, 4632
insect attack, 2870
laminated wood, 4150
marine trials, 4649
particle boards, 4632, 4662
soil composition, 2870
utilisation, 2467, 3968, 3970, 3975, 3977, 4649

Prostephanus truncatus
pheromone-baited trap catches, 3022

Protection, 3600
fires, 2606
insect pests, 2792
marine borers, 2792
wind, 2560
Xyleborus morigerus, 2812

Protoplast isolation
leaves, 610

Provenance collections
seeds, 886

Provenance identification
leaves, 1007

Provenance research
seed origin, 1037
Thailand, 902

Provenance selection
West Africa, 865

Provenance tests
Madhya Pradesh, 1028

Provenance trials, 848, 911, 1045, 1148
Africa, 933
Andhra Pradesh, 1005
Argentina, 1079
Australia, 968
Brazil, 935, 949
breeding, 873, 1039
butt rots, 2710
China, 861, 955, 1047
clonal seed orchard, 4030
Cote d'ivoire, 935
Cuba, 910
Danida Forest Seed Centre, 949
Denmark, 928
FAO, 756, 866, 879
genetic improvement, 791, 799, 866, 874, 1021, 4030
genetic value, 861
genetic variation, 955
Ghana, 935, 949
growth evaluation, 1047
India, 935, 955, 968, 1005, 1024, 1488
Indonesia, 799, 964, 968, 1021
international effort, 928, 949, 1005
IUFRO, 866, 873
Ivory coast, 878, 879
Karnataka, 921
Kerala, 917
Madhya Pradesh, 868
Malaya, 1045
Mexico, 935
Mysore, 921
Nigeria, 881, 882, 883, 910, 935, 955, 968, 989
Papua and New Guinea, 935
plantation establishment, 934
plus trees, 955, 1024
Puerto Rico, 949
seed certification, 893
seed germination, 917, 1459
seed improvement, 893
seed orchards, 2238
seed origin, 921, 939, 963, 973
seed research, 1488
seed treatment, 1488
silviculture, 2238
Solomon Islands, 1012
South East Asia, 933
Sri Lanka, 875, 911, 1039, 1040
statistical methods, 861
Sudan, 968
Tamil Nadu, 1024
Tanzania, 968, 976, 997, 1031
teak improvement, 1024
Thailand, 848, 849, 928, 935, 941, 949, 955, 998, 1027
timber quality, 849
tissue culture, 1024
Tobago, 968
tree breeding, 756
Trinidad, 968
Vanuatu, 1821
vegetative propagation, 928
Venezuela, 791
Vietnam, 968
Virgin islands, 1148
yield, 848, 849

Provenance variation
foliar nutrients, 918
seed germination, 1479

Pruning, 2185
branching, 2040, 2069
stump planting, 2069
Tamil Nadu, 1982

Pseudomonas aeruginosa
bacterial pathogens, 3093
Hyblaea puera, 3093

Pseudomonas solanacearum
bacterial wilt, 2700

Pseudomonas tectonae
bacterial wilt, 2757

Psiloptera fastuosa, 3043

Psittacula krameri, 2991

Puerto Rico
Danida Forest Seed Centre, 949
dendrochronology, 721
mensuration, 3559
plantations, 1863
provenance trials, 949
silviculture, 1223, 1986
site index, 3348
underplanting, 3591
wood properties, 4036

Pulping
anthraquinones, 4727
bark, 4757
veneer waste, 4729

Pulping catalysts
extractives, 606

Pulps
hydrogenolytic degradation, 4318

Pulse transmission technique, 4276

Punjab
cultivation, 2369

Pupal-web formation
Eutectona machaeralis, 3050

Pure teak plantation, 2165
growth, 1971
Myanmar, 2031
plantation techniques, 2142

Trinidad, 2042

Pyinmana Forest Division
mixed plantations, 1330, 2404
natural regeneration, 1330

Pyrausta machaeralis, 2916
Anthia sexguttata, 3166
Beauveria bassiana, 3025
Cremnops atricornis, 3177
fruit formation, 2877
Indonesia, 3023
insecticides, 3204, 3223
integrated pest management, 3164
Java, 2936
Karnataka, 3026, 3027, 3028
light traps, 2844
Madhya Pradesh, 2844
natural enemies, 3174
population dynamics, 3028
predators, 3166
trichogramma, 3175, 3176

Pyrethroids
Eutectona machaeralis, 3199, 3200

Qualitative analysis
decay, 4067
logs, 3532

Quality control
costa rica, 1500, 2170
seed certification, 1500

Quality improvement
breeding, 745

Quality seeds
asia, 1484
genetic improvement, 945

Quality testing
seeds, 1485

Quality timber
intensive management, 3355, 4578
investments, 3721
silvicultural problems, 2047

Quantitative analysis
logs, 3532

Quantitative theory
genetic improvement, 952

Quinones
allergy, 4322
wood extractives, 4363, 4364, 4366, 4379

Qwik-test
seeds, 1586

Radial growth
water balance, 661

Radiography
seed quality testing, 1443, 1487

Rafting
timber measurements, 3273

Rahuri
species trials, 1875

Railways
hardwood logs, 4574
Indonesia, 109, 2522, 4652
Java, 2506
teak forests, 2506, 2522

Raily ecorace
Antheraea mylitta, 2967

Rainfall
erosion, 67
growth, 53, 259, 735
growth rings, 717
Hyblaea puera, 2962
hydrology, 61, 65, 444, 526
interception, 58
litter decomposition, 444
plantations, 67, 526
soil chemistry, 252
soil moisture, 272
soil properties, 259
stemflow, 58, 538
throughfall, 58, 538
vegetation, 252

Rajasthan
degraded forests, 2158, 2225
dry deciduous forests, 1153
fungus resistance, 4497
henna dye, 4756
leaf galls, 2910
rehabilitation, 2158, 2225
teak forests, 1104, 1105, 1106
vegetation ecology, 1153

Random amplified polymorphic d
DNA markers, 1041
genetic diversity, 869
micropropagation, 1705
plus trees, 1041
RAPD, 1041
Thailand, 869
tissue culture, 1705

RAPD variation
breeding, 982

RAPD
plus trees, 1041

Rat attack
plantations, 2685
seedlings, 3079

Rates
royalty, 3766

Rauwolfia serpentina
intercropping, 2386

Reclamation
coal mine areas, 1884, 1924

Reed
underplanting, 2459

Reforestation, 214
Africa, 1850
agroforestry, 2453
Congo, 1144
Cote d'ivoire, 1850
environmental impact, 1913
erosion, 1144
fertilizers, 2299
genetic improvement, 784, 1590
Germany, 1909
Indonesia, 1238
Liberia, 1909
Papua and New Guinea, 1892, 1948
Philippines, 1933, 2299
social forestry, 2460
Sri Lanka, 292, 1537
taungya, 2453, 2460
Thailand, 784, 1590, 1891, 1913
Togo, 214

Regeneration, 966, 1192, 1193, 1194, 1202, 1249, 1275, 1283, 1305, 1308, 1325, 1339, 1342, 1357, 1360, 1368, 1372, 1379, 1911, 1940, 2082, 2099, 2249
agri silviculture, 1377
America, 1275
Anamalai, 1245
Andamans, 1911
Andhra Pradesh, 1207
Angul, 2164
artificial regeneration, 1240, 1324, 1329, 1381, 1618
Bagelen, 1377
bamboo, 1237, 1342, 1378, 1383, 1384, 1388, 1966
Bengal, 2082

Bombay, 1230
Burma, 262, 1276, 1277, 2350, 2484
burning, 339, 1277
calli induction, 1696
Central Provinces, 1327, 1373
coppice, 1232, 1323, 1380, 2233
dibbling, 1323
dry forests, 1329
erosion, 1334
felling, 1262, 1312, 2484, 3590
fires, 1278, 1363
flowered bamboo areas, 1351, 1376
flowers, 1696
forest ecosystems, 1346
forestry, 1305
French West Africa
    federation, 2023
genetic improvement, 966, 1339
Grobogan forest section, 1359
growth, 1363, 1372
Himalaya, 52
Honavar range, 1279, 2058
India, 966, 1247
Indonesia, 1256, 1940
Ivory coast, 2023
Java, 1169, 1254, 1255, 1338, 1940
Kanara plantations, 1354
Kerala, 1341
Madhya Pradesh, 143, 1143, 1159, 1271, 1325, 1353, 1357, 1372, 2233
Madras, 1381
Maharashtra, 1335
management, 2023, 2233, 3803
mixed cropping, 1169
mixed forests, 1353
mixed plantations, 1194, 1237, 1342, 1966
mixed planting, 1257
Mungod pole forest, 1354
Myanmar, 262, 1249, 1257, 1258, 1265, 1319, 1336, 1337, 1376, 1378, 1379, 1383, 1384, 2350, 4395
natural regeneration, 1264, 1324, 1341, 1366, 2233
natural reproduction, 1308
natural succession, 1143
Nigeria, 1281, 2099, 2249
Nilambur plantations, 3837
North Pegu Forest Division, 1334
Orissa, 1342
Pakistan, 1305
Papua and New Guinea, 1243, 1339, 1368
plant diversity, 1159
plantation establishment, 1931
plantations, 1198, 1202, 1265, 2082
planting stock, 1618
reproduction, 1276
research, 1381
seeding habits, 1281
seedling coppice system, 1319
seedlings, 1232, 1363
seeds, 1281
shifting cultivation, 2350
slash burning, 339, 1233, 1234, 1285
soil aeration, 1274
soil properties, 262, 339, 1233
spacing, 1278, 2058
species diversity, 1155, 143
species trials, 1278
stand development patterns, 3378
stump planting, 1618
synecology, 1159
Tamil Nadu, 1381
taungya, 1257, 1258, 1320, 2326, 2350, 2484
teak forests, 1143, 1207, 1263, 1335, 1360, 1361, 1365, 2233, 4395
Thailand, 1202, 1278, 1283, 1326
Thana, 1335
thinning, 2213
Trinidad, 1931
United Provinces, 1110
Uttar Pradesh, 52, 1232
Uttaranchal, 1346
vegetation, 52, 143, 339
Vidharbha, 1264
weeding, 2164
yield, 1110, 2058

Regreening programme
    Java, 1944

Regression technique
    volume tables, 3367

Rehabilitation
    afforestation, 535
    agroforestry, 1906
    cultivation, 268
    degraded forests, 1882, 1898, 1906, 2158, 2225
    Ivory coast, 535
    Myanmar, 1898
    Rajasthan, 2158, 2225
    savanna, 535
    social forestry, 1906
    soil conservation, 535
    soil properties, 294

Relascope
    height measurements, 3371

Released strain
    growth rate, 3554

Rembrangsche teak forest
    management, 2035

Remote sensing
    Karnataka, 3254, 3454
    landsat digital data, 3240
    landsat MSS data, 3254, 3454
    mapping, 3240
    resource assessment, 3486
    trunk diameter, 3541
    Uttar Pradesh, 3486

Replanting
    soil fertility, 167
    stand improvement, 2062

Report
    Teak sub commission, 4770

Reproduction
    fires, 1228, 2618
    nutrient dynamics, 644
    propagation, 1744
    regeneration, 1276
    root suckers, 1741, 1780
    seeds, 1295
    teak forests, 1228

Reproductive behaviour
    Hyblaea puera, 3096

Reproductive biology
    clonal seed orchard, 990
    floral characteristics, 980

Reproductive phenology
    clonal seed orchard, 991

Reproductive traits
    clonal variation, 899, 1036

Research
    artificial regeneration, 1381
    China, 40

India, 1212, 1215
Kerala, 5, 1180
Madras, 1381
Nilambur, 1180
plantation establishment, 2239
regeneration, 1381
seed germination, 2239
silviculture, 40, 1180, 2239
Tamil Nadu, 1381
Thailand, 2239
thinning, 2245

Resin treatment
veneer, 4674

Resistance
decay, 2742
Limnoria bombayensis, 4517
marine borers, 4563

Resistance behaviour
natural weathering, 4456

Resource assessment
geographical information system, 3486
remote sensing, 3486
Uttar Pradesh, 3486
yield prediction, 3457
yield tables, 3534

Resource economics
Kerala, 3704

Resource survey
Karnataka, 3241

Resources
Asia Pacific, 1142
home gardens, 3399
Kerala, 3399
Myanmar, 3784
Thailand, 3493
utilisation, 4641
Wyanad, 4013

Reticulitermes
termites, 2811

Reticulitermes flavipes, 3066, 3220

Review
defoliators, 2980
diseases, 2569, 2693, 3010
fertilizers, 2295
fruiting, 1495
genetic improvement, 1046
history, 3830
Hyblaea puera, 3053
India, 1130, 1442
Indonesia, 3010
insect pests, 2569, 3010
Java, 2569
Madhya Pradesh, 595
Myanmar, 3830
phytochemistry, 595
plantation techniques, 2090
seed germination, 1496
seed storage, 1442, 1495
silviculture, 17, 1196, 2056
site quality, 257
strength properties, 4247
teak oil, 4316

Rheological properties
extractives, 4341

Rhizoctonia solani
collar rot, 2689, 2764, 2765, 2767

Rhizosphere
agroforestry, 487

Rhizosphere microflora, 480, 505

Rhodesia
irrigation, 2272

Rhyncaphytoptid gall mites, 3002

Rice
intercropping, 2389

Rigidoporus lignosus
root rot, 2751

Ring formation, 727

Roads
Indonesia, 109
Java, 2506

Rock phosphate
acid phosphatase, 475

Root activity, 703
spacing, 2199

Root biomass
productivity, 3530, 3531

Root competition
thinning, 2250

Root damage
plantation trials, 2676

Root formation
age, 650
culm cuttings, 1718
stem cuttings, 1717
stump planting, 1673

Root fungus, 2725

Root grafts
vegetative propagation, 1693

Root growth, 659
seed germination, 1183
soil moisture, 384

Root knot
nurseries, 2776, 2985

Root penetration
soil properties, 308

Root regeneration
clonal propagation, 1720

Root rot
Amylosporum campbellii, 2781
Armillaria mellea, 2726
Fomes lignosus, 2758
fungus diseases, 2726
Helicobasidium compactum, 2728, 2729, 2730
Nigeria, 2752, 2753, 2754, 2758
nurseries, 2728, 2729
patch mortality, 2738
Peniophora, 2695
Peniophora rhizomorpho-sulphur, 2696
Polyporus zonalis, 2695, 2696
Rigidoporus lignosus, 2751

Root suckers
reproduction, 1741, 1780
shoot production, 1703

Root system, 651

Root termites
root trainers, 3103

Root trainers
diseases, 2749
growth, 1656
nurseries, 2749
nursery practices, 1637
plantation raising, 1636
planting stock, 1638
seedlings, 1656, 3103
stump planting, 1636, 1656
stumps, 1656

Rooted cuttings
clonal propagation, 1755
planting stock, 1766
rooting, 2081
seedling age, 1690
seedlings, 1797

Rooted stumps
growth, 2193

Rooting, 2081, 3397
adventitious roots, 1676
auxins, 1761

branch cuttings, 1681, 1682, 1764, 1765
bud grafting, 1719
budding, 1763
clones, 1691
coppice, 1802
cuttings, 1740
etiolation, 1719
field trials, 1689
genotypes, 1686
gibberellic acid, 1694
grafting, 1763, 1802
growth hormones, 1764
growth, 2110
hardening, 1786
hormones, 1681, 2110
macropropagation, 1763
micropropagated shoots, 1786
seedlings, 1738
shoot cuttings, 1738, 1802
stem cuttings, 1761, 1768
survival, 1686, 1689
tissue culture, 1686, 1689
vegetative propagation, 1676, 1681, 1682, 1735, 1740, 1764, 1765, 1768, 1802

Rootless stumps
growth, 2193

Roots
age effect, 3460
biomass, 656
distribution, 705, 3460
medicinal properties, 598
nutrient status, 695
provenance trials, 2710
seasonal variation, 362

Rosellinia dimidiata, 2759

Rosengan
ecology, 1064
silviculture, 1179

Rot, 2761

Rotary cutters
harvesting, 2531

Rotation, 2016, 2019, 2020, 2132, 2198, 2201, 2255, 3618
age, 86, 3705
carbon, 192
cost benefit analysis, 2127
crop rotation, 2009
density, 3705
economic analysis, 2027
economics, 2127, 3727
felling, 3618
fuelwood, 3485
growth, 3487
investments, 3727, 3777
management, 3705
natural regeneration, 2149
nitrogen, 192
plantations, 192, 2021
poles, 3485
price-age gradient, 2201
productivity, 2027, 3487, 3705
site quality, 86, 2095, 3618
soil chemistry, 192
teak forests, 2016, 2019, 2054, 2055, 2057, 2060, 2061, 2232
volume tables, 2021
yield, 2054, 2055, 3727

Royalty
Burma, 3587, 3702
Myanmar, 3674
Trinidad, 3766

Rubber content
wood properties, 4056

Rust
Chaconia tectonae, 2763
clonal resistance, 4489
nurseries, 2739
Olivea tectonae, 2777, 4489
uredospore, 2745

Saccharum spontaneum
weeds, 1916

Sahyadrassus malabaricus, 2833, 2981, 3094
biological control, 3131, 3132
insecticides, 3215

Sal
interplanting, 2432
succession, 82

Saline soil
species trials, 1875

Saline solutions
seed germination, 1396

Salt stress
seed germination, 1396

Salt tolerance
intercropping, 2363

Sampling, 3249, 3253

Sand culture
nutrient deficiency, 586

Sand heat treatments
dimensional stabilization, 4549

Sand minerology
soil fertility, 239

Sanding
wood properties, 4236

Sanding qualities
surface treatment, 4409

Santalum album
mixed plantations, 2451

Sapling borer
coelosterna, 3109

Saplings
coccids, 2934
defoliation, 2853
dunctiferalis, 2934
Eutectona machaeralis, 2801
growth, 2853

Saprophytic fungi, 2768

Sapwood heartwood relationship
physical properties, 4079

Sapwood
bark thickness, 3517
foliage, 3430, 3431, 3334, 3335, 4103, 4244, 4314
histochemistry, 4314
pipe model theory, 3430
strength properties, 4244

Sarcinella tectonae, 2731

Sarcoscyphaceous fungi
Acervus epispartius, 2762

Satpura plateau
litter decomposition, 436

Satpuras
site factors, 73

Savanna
afforestation, 535, 1902
ivory coast, 535, 1902, 2160
plantation establishment, 2160
rehabilitation, 535
soil conservation, 535
species introduction, 2160

Sawdust
charcoal, 4431, 4442, 4443
chemical treatment, 4557
eczema, 599
fodder, 4753
identification, 4095
incense, 4755
Lentinus edodes, 4761

pelleting, 4557
toxicants, 599
Sawing, 4284, 4393
Sawmilling
industry, 3950, 3961
Sawnwood
exports, 3933
grading, 4612
Saws
felling, 2521
working properties, 4416
Scaling, 4604
Schleichera oleosa
mixed cropping, 2457
Sclerotium rolfsii, 2774
Screenometer
inventory, 3252
Screws holding power
nail holding properties, 4278
Seasonal behaviour
vascular cambium, 734
Seasonal changes
vascular cambium, 4146
Seasonal distribution
Hyblaea puera, 3032, 3033
starch, 615
Seasonal incidence
Eutectona machaeralis, 3091
Hyblaea puera, 3015
Seasonal production
phloem, 4144
xylem, 4145
Seasonal variation
anatomy, 699, 733
carbohydrates, 313
dendrochronology, 736
infection, 476
litter decomposition, 446
litter production, 3326
phloem, 4121
soil chemistry, 441
soil fungi, 446
soil properties, 362
spatial distribution, 362
vascular cambium, 736
vesicular arbuscular mycorrhizae, 476
wood formation, 724
Seasonality
coppicing, 2034
litter production, 3297
Seasoning behaviour
kiln drying, 4560
Seasoning defects
wood properties, 4187
Seasoning, 3973
cooperage woods, 4559
girdling, 4535, 4536
grain contraction, 4553
machining properties, 4036
seed treatment, 3973
solar drying, 4564
superheated steam, 4545
wood defects, 4553
Seed age
seed germination, 1529
Seed banks
Costa Rica, 1407
molecular maps, 1029
Seed certification, 893
quality control, 1500
Seed characteristics, 1602
Seed collection, 1452, 1603
genetic improvement, 1048
review, 1495
seed germination, 1515
seed orchards, 1001
seed production, 562
seed sources, 1428
seed storage, 562, 1486, 1495
seed treatment, 562
Seed dispersal, 1519
Seed dormancy, 690
Seed emptiness
seed germination, 1517
Seed extraction
machine, 1454
seed germination, 1435
Seed germination, 577, 579, 690, 917, 930, 1049, 1131, 1183, 1228, 1394, 1395, 1400, 1401, 1403, 1404, 1408, 1411, 1413, 1415, 1416, 1417, 1420, 1426, 1429, 1432, 1434, 1468, 1469, 1472, 1473, 1481, 1482, 1489, 1491, 1492, 1493, 1497, 1498, 1499, 1501, 1503, 1524, 1525, 1526, 1527, 1529, 1532, 1533, 1538, 1540, 1542, 1546, 1548, 1551, 1554, 1555, 1558, 1561, 1564, 1569, 1570, 1571, 1573, 1575, 1577, 1579, 1585, 1591, 1592, 1596, 1599, 1600, 1683, 1778, 2204, 2239
accelerated ageing, 1509
acetic acid, 1499
acid treatment, 1418, 1429, 1432, 1481, 1497, 1499, 1504, 1552, 1561, 1592
age, 1393, 1449, 1489, 1492
ageing, 1513, 1514
allelopathy, 573, 577, 578, 579, 602, 611, 624, 1577
calcium, 1445
calcium carbonate, 1551
chilling, 1544
chlorophyll deficient seedling, 1401
clonal variation, 1516
crown directions, 1433
dibbling, 1578, 1579
drupe characters, 1566
emptiness, 1542
fertilization, 1415
fires, 1228
fruit size, 1403, 1404, 1449, 1498
fungicides, 1576
gamma ray irradiation, 1482
germination medium, 1555
gibberellic acid, 1588
gibberellin, 1501
Glomus macrocarpus, 1588
growing media, 1511
growth, 1460, 1517, 2239
growth hormones, 1576
heat treatment, 1491
heating, 1544, 1552
hydrochloric acid, 1481, 1497
hydrogen peroxide, 1510
International provenance testing, 1490
leaf leachates, 602
light, 1447, 1540
notching, 1562, 1595
nursery techniques, 1612
orientation, 1399
oven method, 1421
physiological assessment, 1518
plant extracts, 1577
plantation establishment, 1826, 2239
plantation management, 2204

plus trees, 1520
pollen, 1433, 1683
potassium nitrate, 1512
presowing treatments, 1424, 1469
provenance trials, 917, 1459
provenance variation, 1479
reproduction, 1228
review, 1496
root growth, 1183
saline solutions, 1396
salt stress, 1396
seed age, 1529
seed collection, 1515
seed dormancy, 690
seed emptiness, 1517
seed extraction, 1435
seed microflora, 1560
seed orchards, 1416, 1433
seed origin, 1462
seed processing, 1549
seed production, 1503
seed size, 1393, 1395, 1473, 1523, 1532
seed sources, 1472
seed storage, 1419, 1435, 1438, 1450, 1455, 1503, 1539, 1570, 1591
seed testing, 1427, 1438
seed treatment, 1394, 1402, 1405, 1413, 1423, 1427, 1430, 1441, 1444, 1446, 1467, 1471, 1507, 1510, 1512, 1518, 1521, 1525, 1526, 1527, 1529, 1531, 1533, 1540, 1546, 1549, 1554, 1585, 1587, 1594, 1598, 1599, 1600, 2239
seed viability, 1584
seedling development, 1469
seedling growth, 1395, 1447, 1523, 1541, 1560, 1588
seedling production, 1612
seedling survival, 1472, 1492, 1655
seedling vigour, 1473, 1492, 1504, 1508, 1509, 1510, 1512, 1513, 1514, 1515
seedlings, 1468
silviculture, 2239
soaking, 1426, 1446, 1552, 1558, 1561, 1571, 1575, 1625
soil types, 1399
source variation, 1450
sowing, 1417, 1508, 1579, 1612
spacing, 1655
sulphuric acid, 1402, 1552, 1558, 1561, 1592
termite aided mesocarp removal, 1423
tree age, 1524
tree size, 1434

Seed improvement
provenance trials, 893
seed orchards, 957

Seed longevity
humidity, 1398

Seed management
India, 1458

Seed microflora
seed germination, 1560

Seed morphology, 1601

Seed oils
chemical composition, 566

Seed ontogeny
breeding, 1565

Seed orchards, 876, 927, 954, 1433
acanthophorus, 2909
Andhra Pradesh, 954
Asphondylia tectonae, 2863
Bangladesh, 265, 1480
breeding, 863, 931, 1480
budding, 1716, 1795
clonal seed orchard, 896
clonal variation, 1000
clones, 822, 927, 1785, 2863
coppice shoots, 1006
Costa Rica, 979, 3413
country reports, 1458
embryogenesis, 822
fertility variation, 1035
fertilization, 822
field manual, 876
flowering, 830, 908
fruit production, 810, 830, 3216
fruiting, 3037
gall midge, 2863
genetic improvement, 863, 880, 936, 952, 953, 954, 970, 1000
grading, 953
grafting, 936, 995, 1785
hormones, 3216
India, 1458
Indonesia, 822, 1001
insect pests, 3125
insecticides, 3216
low fruit production, 896
Madhya Pradesh, 953, 1011, 1785, 2434
Maharashtra, 870, 957, 958, 969, 2909
Malaya, 929
Nigeria, 931
plantation evaluation, 3413
plantations, 265
planting stock, 1716
plus trees, 954, 958, 995
pollen, 1433
pollination, 822
provenance trials, 2238
quantitative theory, 952
seed collection, 1001
seed germination, 1416, 1433
seed improvement, 957
seed management, 1458
seed origin, 880
seed production areas, 969
seed production, 796
seed stand establishment, 979
seed treatment, 1410
silviculture, 1011, 2238
soil properties, 265
stand characteristics, 970
stylosanthes, 2434
superior phenotypes, 953
Tamil Nadu, 880
Thailand, 810, 863, 929, 993, 1410, 1416
underplanting, 2434
Uttar Pradesh, 796, 1006
vegetative propagation, 958, 995, 1716, 1795
Walayar, 1409
weed control, 2434

Seed origin, 864, 975, 1018, 2220
branching, 962
Brazil, 4049
clonal origin, 975
Coorg, 962
gangetic alluvium, 1018
genetic improvement, 880
growth, 975
India, 859, 2220
Indonesia, 1941
Java, 975
Karnataka, 921
molecular characterization, 994

Myanmar, 859
Mysore, 921
plantation establishment, 962, 1927, 1941
provenance research, 1037
provenance trials, 921, 939, 963, 973
seed germination, 1462
seed orchards, 880
species selection, 753
Sri Lanka, 1927
Tamil Nadu, 880
wood quality, 1002, 1014, 4049

Seed planting
seedling growth, 1453

Seed processing, 1550
machine, 1461
seed germination, 1549

Seed production areas
management, 972
seed orchards, 969

Seed production
Asia, 1484
Bangladesh, 1503
breeding, 977, 1086, 1565
clonal seed orchard, 990
floral characteristics, 980
flowering, 887
foliar nutrients, 974
genetic analysis, 871
genetic improvement, 887, 977, 980, 1590
genetic variation, 974
India, 977
Indonesia, 990
pollination, 828
quality seeds, 1484
reforestation, 1590
seed ontogeny, 1565
seed orchards, 796
seed storage, 562, 1503
Thailand, 1590, 828
Uttar Pradesh, 796

Seed protein
albino rats, 605

Seed quality, 1422, 1487, 1553

Seed quantity
planting stock, 1593

Seed rates
sowing, 1474

Seed research
provenance trials, 1488

Seed situation
Thailand, 1567

Seed size
age, 1393
seed germination, 1393, 1395, 1473, 1523, 1532
seedling growth, 1395, 1523
seedling height, 1392
seedling vigour, 1473
stump size, 1556

Seed sources
molecular characterization, 994
seedling survival, 1472
Solomon Islands, 1428

Seed sowing
seed storage, 1615

Seed stand establishment, 798
seed orchards, 979

Seed storage, 562, 1486
Bangladesh, 1503
humidity, 1398
India, 1442
Madhya Pradesh, 1477
microflora, 2850
review, 1442, 1495
seed germination, 1419, 1435, 1438, 1450, 1455, 1503, 1539, 1570, 1591
seed longevity, 1398
seed sowing, 1615
seed testing, 1438
seed treatment, 562, 1410
seed viability, 1477
source variation, 1450
storage containers, 1477
Thailand, 1410, 1570, 1572, 1591
Vietnam, 1486

Seed technology, 1506

Seed testing
radiography, 1443
seed germination, 1427, 1438

Seed treatment, 562, 1410, 1414, 1536
bacterial action, 1563
Burma, 1394
China, 1599
collar rot, 2767
France, 3973
ghana, 1529
growth, 2239
hydrogen peroxide, 1510
India, 1488
Kerala, 1585
light, 1540
machine, 1406
Malawi, 1526, 1527
Myanmar, 1413, 1414
Panama, 1546
physiological assessment, 1518
plantation establishment, 2239
potassium nitrate, 1512
provenance trials, 1488
research, 2239
Rhizoctonia solani, 2767
seasoning, 3973
seed germination, 1394, 1402, 1405, 1413, 1423, 1427, 1430, 1441, 1444, 1446, 1467, 1471, 1507, 1510, 1512, 1518, 1521, 1525, 1526, 1527, 1529, 1531, 1533, 1540, 1546, 1549, 1554, 1585, 1587, 1594, 1598, 1599, 1600, 2239
seedling vigour, 1510, 1512
soaking, 1446
Sri Lanka, 1525
sulphuric acid, 1402
termite aided mesocarp removal, 1423
Thailand, 1410, 1533, 1540, 2239
thinning, 3973
Tripura, 1600
Uttar Pradesh, 1554

Seed viability
seed germination, 1584
seed storage, 1477

Seed weight, 1464

Seededness
fruits, 706

Seeding density
planting stock, 1412

Seeding habits
regeneration, 1281

Seedling age
rooted cuttings, 1690

Seedling coppice system
regeneration, 1319

Seedling development

presowing treatments, 1469

Seedling diseases
nurseries, 2735

Seedling evaluation, 668

Seedling growth, 1395, 1447, 1453, 1474, 1478, 1523, 1541, 1560, 1588, 1646, 1652, 1658, 2281
age, 1663
allelopathy, 607
arbuscular mycorrhizae, 517
culling, 1665
defoliation, 2795
dry matter production, 1395
fertilizers, 2795
gibberellic acid, 1588, 1648, 1651, 1663, 1664, 1747
Glomus macrocarpus, 1588
growing media, 1661
growth regulators, 2292
growth stimulators, 607
growth substances, 1789
humic acid, 2281
leaf extract, 607
light intensity, 1447
micronutrients, 2298
mycorrhiza, 485
nutrient uptake, 2281
nutrients, 1651
planting stock, 1661, 1665, 1789
polybag size, 1646
potting media, 1609, 1672
seed microflora, 1560
seed rates, 1474
seed size, 1395, 1523
shade, 1658
sowing, 1474
spacing, 1652
vesicular arbuscular mycorrhizae, 486, 517

Seedling height
seed size, 1392

Seedling morphology
weed control, 1647

Seedling production
nursery techniques, 1612

Seedling quality
soil mixtures, 1660

Seedling raising
dona technique, 1662

Seedling survival
age, 1492
seed sources, 1472
shade, 1667
spacing, 1655

Seedling vigour, 1473, 1492, 1504, 1508, 1509, 1510, 1512, 1513, 1514, 1515
accelerated ageing, 1509
acid treatment, 1504
ageing, 1492, 1513, 1514
hydrogen peroxide, 1510
potassium nitrate, 1512
seed size, 1473
vesicular arbuscular mycorrhizae, 510

Seedlings, 285, 477, 510, 542, 604, 633, 1232, 1468, 1642, 1654, 1656, 1700, 2314, 2315, 3103
abnormalities, 710
age, 1649
arbuscular mycorrhizal colonization, 507
azotobacter inoculation, 504
bacterial wilt, 2700, 2715, 2769
Baikiaea plurijuga, 1896
biomass production, 504, 3408
cattle manure, 2269
clones, 518
collar rot, 2689
compost, 2269
conjointed quadruplet seedling, 708
copper belt, 1896
coppice, 1232, 1843
cultivation, 1843, 1897, 1914
defoliation, 2854
diseases, 2705
dry matter production, 1748, 3578
Eutectona machaeralis, 2800
fertilizers, 504, 1670, 2264, 2314, 2315, 2319
fires, 1363
flowering, 633
foliar nutrients, 918
fungus diseases, 2769
gibberellic acid, 1700
grass, 2367
growth rate, 1634
growth regulators, 1748, 1782
growth, 542, 1363, 1614, 1656, 1700, 1797, 2367, 3578
Hapalia machaeralis, 2854
Hyblaea puera, 2854
indole acetic acid, 1748
inorganic fertilisers, 2315
leaf area estimation, 3438
micronutrients, 621
morphology, 708, 710
mycorrhizal colonisation, 518
natural forests, 1343
NPK fertilizers, 2269
nurseries, 504, 1642, 1654, 1670
nursery period, 1649
nutrient deficiency, 285, 585, 621, 2294
nutrient uptake, 1614
nutrients, 604
production costs, 1654
provenance variation, 918
Pseudomonas solanacearum, 2700
rat attack, 3079
regeneration, 1232, 1363
Rhizoctonia solani, 2689
root termites, 3103
root trainers, 1656, 3103
rooted cuttings, 1797
rooting, 1738
seedling vigour, 510
shoot cuttings, 1738, 1797
species trials, 1896
stump planting, 1656
stumps, 1649, 1656
teak forests, 1896
vesicular arbuscular mycorrhizae, 477, 504, 510, 518
water conservation, 542
wildlife damage, 1896

Seeds, 907, 1281, 1295, 1537, 1568, 2722
dibbling, 1530
fires, 1242
fungi, 2722
genetic analysis, 871
germinability, 1559
humidity, 1586
insect pests, 2884
natural forests, 1391
natural regeneration, 1242
plantation grown teak, 1391
presowing treatments, 1469

provenance collections, 886
quality testing, 1485
qwik-test, 1586
regeneration, 1281
reproduction, 1295
seed germination, 1469
seed production, 871
seeding habits, 1281
seedling development, 1469
sowing, 1530
spermoplane microflora, 1559
x-ray test, 1485

Selection, 803

Selection criterion
genetic variation, 860
timber quality, 860

Selective logging
yield, 2511

Seminar proceedings
India, 2
Kerala, 1
Malaysia, 1964
plantation establishment, 1964
productivity, 3347
silviculture, 2

Senegal
plantations, 1333, 3741
yield, 1333, 3741

Serratia marcescens
bacterial pathogens, 3093

Sewage
fertilizers, 2277

Sewage water
irrigated plantations, 2288

Sex pheromone
Xyleutes ceramica, 3021

Shade, 62
seedling growth, 1658
seedling survival, 1667
stomatal conductance, 638

Shaping
plantation grown teak, 2152

Shear deflection
wood properties, 4169

Shelterbelt
Eucalyptus tereticornis, 2452
plantations, 2452

Shifting cultivation
regeneration, 2350
species composition, 1893

Ship building
Karnataka, 4390

Ship deck
wood properties, 4208, 4299

Ships
wood properties, 4292

Shoot borer
Hypothenemus pusillus, 2873

Shoot cuttings
planting stock, 1766
rooted cuttings, 1766, 1797
rooting, 1738, 1802
storage technique, 1737
vegetative propagation, 1737, 1802

Shoot growth
clones, 660
dormancy periods, 654

Shoot production
micropropagation, 1709
root suckers, 1703

Shoot revival, 1996

Shot-holing
Dinoderus pilifrons, 3134
Tribolium castaneum, 3134

Shrinkage, 4201, 4231, 4232, 4233, 4261
grading, 4608
moisture content, 4344

Siam, 3706, 3943, 4168
chemical properties, 4179
conservation, 3941
exports, 3943
flowering, 637
industry, 3946, 3947, 3948, 3949
logging, 2501
marketing, 3557
protection, 3600
shifting cultivation, 1893
silviculture, 246
teak forests, 3799
trade, 3872, 3887, 3890, 3891, 3912, 3926, 3941
wood properties, 3985

Sidajoe
plantation establishment, 3635

Sieve elements
phloem rays, 698

Sikkim
phytosociology, 1075
soil properties, 248

Silage
leaves, 408, 409

Silica
chemical composition, 4304
heartwood, 692
wood chemistry, 4377

Silicon
clay minerals, 200

Silvicultural characteristics
stand curve analysis, 1204

Silvicultural management
Malaysia, 2122
sustained yield, 3851

Silvicultural problems
quality timber, 2047

Silvicultural research
mixed plantations, 1172

Silvicultural systems
coppice, 2049
felling, 383
soil conservation, 316
soil properties, 360, 383

Silvicultural techniques
Java, 2017
Madhya Pradesh, 152
Myanmar, 1249
Papua and New Guinea, 1386
teak forests, 2017

Silvicultural treatments
timber production, 2274
Venezuela, 2520

Silviculture, 2, 14, 15, 16, 40, 49, 55, 457, 1225, 1307, 1854, 1927, 1960, 1962, 1972, 2013, 2056, 2063, 2066, 2107, 2108, 2119, 2126, 2134, 3437, 3463, 3594, 3782, 3796, 4032
afforestation, 1619
Africa, 1076, 1182, 1184, 1203, 2063, 3741
America, 1205, 1275
Andamans, 1911
Andhra Pradesh, 2067, 2118
Asia, 2108
Bengal, 2082
Brazil, 1825
Burma, 1200, 4768
China, 16, 40
Costa Rica, 1219, 3782

Cote d'ivoire, 1184
country reports, 49
Dahomey, 1174, 1206, 3641
Danish Thai Teak
Improvement Centre, 1225
Dutch East Indies, 1973
economics, 12
El Salvador, 1221
France, 1119
Gold Coast, 1201
Honduras, 1218
India, 2, 12, 15, 49, 1171, 1182, 1185, 1217, 1973, 2108, 2220
Indonesia, 1195, 2022, 2108, 4767
International cooperation, 16
International Teak Commission, 4767
investments, 3779, 3782, 3796, 4032
Ivory Coast, 1887
Java, 1177, 1960
Kerala, 14, 1180, 1216, 3679, 3796
Madelena project, 1218, 1219, 1220, 1221, 1222
Madhya Pradesh, 55, 1011, 1210, 1325, 1357, 1372, 2119
Maharashtra, 2109
Malaya, 1961, 1962, 2014
mixed cropping, 2335
mixed plantations, 1170, 1194, 2126, 2444
Myanmar, 1170, 1182, 1185, 1379, 2108, 2134
Nicaragua, 1220
Nigeria, 1116, 2099, 2249
Nilambur, 1180
nursery techniques, 1619, 2014
Pakistan, 1175, 1185, 1305
Panama, 1222
Papua and New Guinea, 1339, 1368
plantation establishment, 1825, 1887, 1927, 1952, 1961, 1962, 2063, 2239
plantation grown teak, 1184
plantations, 11, 1119, 1202, 2082, 2109, 3741
planting stock, 1961
productivity, 11, 3437, 3796
provenance trials, 2238
Puerto Rico, 1223, 1986
regeneration, 1192, 1193, 1194, 1202, 1275, 1305, 1308, 1325, 1339, 1357, 1360, 1368, 1372, 1379, 1911, 2082, 2099, 2249
research, 40, 1180, 2239
review, 17, 1196, 2056
Rosengan, 1179
seed germination, 2239
seed orchards, 1011, 2238
seed origin, 1927, 2220
seed treatment, 2239
Seminar proceedings, 2
Senegal, 3741
Siam, 246
Solomon Islands, 1181, 2157
South East Asia, 2107
spacing, 3490
species introduction, 1076, 1116
species trials, 2157
Sri Lanka, 1927, 3463
stand density, 3490
stump planting, 1808
Sudan, 2066
Tamil Nadu, 1168
taungya system, 2335
teak forests, 1210, 1214, 1225, 1360
TEAKNET, 16
Thailand, 1182, 1185, 1202, 1214, 1225, 2013, 2108, 2150, 2239
thinning, 3490
timber quality, 4032
Tobago, 2156
Togo, 3779
Trinidad, 1197, 1223, 2134, 2156
Turrialba, 2335
Uttar Pradesh, 2092
Venezuela, 1223
West Indies, 2156
wood properties, 7, 12
World, 11
yield, 1116, 1972, 2150, 3641, 3741, 3779

Singapore
grading school, 4599
investments, 3795

Single stem silviculture
thinning, 2209, 2210, 2211, 2212, 2221, 2226

Site characteristics
Madhya Pradesh, 321

Site class assessment
site quality, 91

Site classification
Bihar, 400
Caribbean, 94
Central America, 94
China, 98
Colombia, 94
Indonesia, 90
Java, 90
Malaysia, 312
soil properties, 400
Venezuela, 94
yield, 3368

Site factors, 56, 99, 2667, 4013
Bamonpokri teak plantations, 2004
biomass production, 3415
distribution, 73
growth, 100, 111, 3582
insect pests, 3076
Loranthus, 2667
mechanical properties, 4275
mixed plantations, 96
nutrient uptake, 3582
physical properties, 4275
plantation establishment, 95, 106, 2004
productivity, 3659
site index, 100, 105, 111
stump storage, 97
timber quality, 4111
wood density, 4198
yield, 105

Site index
growth, 100, 111
Indonesia, 3308, 3358
Nigeria, 84, 3281
plantations, 84
productivity, 3417
Puerto Rico, 3348
site factors, 100, 105, 111
Solomon Islands, 102
Taiwan, 111
yield tables, 3281
yield, 105

Site preparation
slash burning, 347

Site quality, 282, 324, 342

central America, 92
dris evaluation, 88
felling, 3618
form quotient, 4046
growth modelling, 3549
growth rate, 3609
growth, 324
height, 103, 3475
investments, 3523
Lampang teak plantations, 110
laterisation, 257
mixed deciduous forests, 108
organic matter, 342
plantations, 93, 103
productivity, 3491, 3523
review, 257
rotation, 86, 2095, 3618
site class assessment, 91
soil aggregate, 108, 324
soil nutrients, 88
soil properties, 85, 172, 282, 301, 342
yield prediction, 3411
yield tables, 3491
yield, 88, 3550

Site requirements, 80

Site selection
growth, 3535
planting, 89
soil properties, 107, 331

Site technology
productivity, 395, 3347

Siwalik Forest Division
soil properties, 353

Skidding, 2553

Slash burning
growth, 218
planting, 2068
planting area, 1976, 2104
regeneration, 339, 1233, 1234, 1285
site preparation, 347
soil properties, 217, 218, 339, 347, 1233
taungya, 218
vegetation, 339
weed growth, 218

Sleepers
production economics, 4652

Slicing characteristics
veneer, 4685

Sloping land
soil properties, 232
water conservation, 1907

Small dimensional timbers
technology transfer, 4394

Smallholder participation
agroforestry, 2430

Smuggling
Thailand, 2549

Snail, 3045

Snow resistance, 70

Snowfall, 70

Soaking
seed germination, 1426, 1446, 1552, 1558, 1561, 1571, 1575, 1625

Social forestry
degraded forests, 1906
Indonesia, 3858
investments, 3724
Malaysia, 1868
reforestation, 2460
Thailand, 1873, 3724

Socio economics, 3630
agroforestry, 2433
environmental conservation, 3802

Sodic soils, 330

Soft rot
field tests, 2708

Soil aeration
mulching, 228
regeneration, 1274

Soil aggregate
alluvial soils, 363
growth, 324
mixed deciduous forest, 108

Soil assessment, 247

Soil bearing teak
soil deterioration, 161

Soil biology
chemical properties, 267
microorganisms, 503

Soil chemistry, 220, 266, 314, 340, 341, 354, 355, 367, 369, 389, 442
biomass production, 276
calcicole, 299
calcium, 402
carbon, 188, 192, 361
clay minerals, 200, 327
copper, 296
deficiency, 404
heterotrophic nitrification, 502
hydrology, 548
iron, 412
Klangdong teak plantation, 284
lateritic belt, 368
litter, 411, 412, 419, 442
Mae Huad Teak Plantation, 378
microbiology, 499
mortality, 320
nitrification, 411
nitrogen, 192, 441
nutrient release, 288
nutrients, 241, 303, 361, 370, 404
plantations, 187, 188, 192
potassium, 250
rainfall, 252
rehabilitation, 294
rotation, 192
seasonal variation, 441
silicon, 200
soil fungi, 474
soil organic matter, 271, 344, 474
vegetation types, 296, 322
vegetation, 252

Soil classification, 377

Soil climate, 325

Soil compaction, 328
infiltration capacity, 329

Soil composition
Xyleutes ceramica, 2870

Soil conservation, 531, 539
afforestation, 535
agriculture policy, 529
gal formation, 2890
Itonididae cecidmemyildal, 2890
rehabilitation, 535
savanna, 535
silvicultural systems, 316
underplanting, 2459

Soil degradation, 237
monoculture plantation, 231

Soil density
root growth, 384

Soil depth
growth, 336, 337

height, 373
log volume, 395

Soil deterioration, 226
Nilambur plantations, 216
soil bearing teak, 161

Soil erosion, 524, 528
afforestation, 1949
clear felling, 530
degraded soil, 1949
fires, 543
mixed cropping, 2336
soil conservation, 316, 539
soil fertility, 316
taungya, 2336

Soil fertility, 213, 225, 289, 391, 473, 3392
fallow land, 385
farm lands, 319
fertilizers, 270
forestry, 385
nutrients, 2325
plantations, 225, 270, 352, 391, 1333
replanting, 167
sand minerology, 239
silvicultural systems, 316
soil mites, 473
soil properties, 225, 352, 353
termites, 492
wildlife, 352
yield, 1333

Soil fungi, 493
arbuscular mycorrhizae, 482
distribution, 511
litter decomposition, 446
micro fungi, 495
soil organic matter, 474
spore population, 482

Soil insecticides
nurseries, 3212

Soil loss
plantations, 544

Soil management
soil erosion, 2336

Soil mapping
plantations, 293

Soil microorganisms, 500
herbicides, 471
organic matter, 452
vegetation, 481

Soil mites
soil fertility, 473

Soil mixtures
seedling quality, 1660

Soil moisture
bulk density, 384
chemical properties, 325
litter decomposition, 275
plantations, 229, 230, 317
rainfall, 272
root growth, 384
soil climate, 325
soil density, 384

Soil nutrients, 166, 263, 290, 334, 379, 2595
artificial regeneration, 1298
biomass, 264
burning, 1298
fertilizers, 196, 461
fires, 2595
green manures, 147
growth, 461
leaf nutrients, 394
microorganisms, 398
plant density, 290
plantations, 196, 242, 334
productivity, 394
soil organic matter, 379
yield, 88

Soil organic matter, 379
nutrients, 470
soil fungi, 474
soil properties, 189, 271, 344

Soil physics, 318

Soil productivity
soil properties, 388

Soil properties, 55, 85, 104, 107, 162, 166, 169, 183, 198, 199, 211, 212, 219, 220, 221, 222, 223, 225, 236, 242, 243, 244, 245, 248, 249, 251, 253, 254, 256, 259, 261, 262, 265, 266, 269, 274, 277, 282, 283, 294, 298, 300, 308, 310, 311, 314, 321, 322, 331, 340, 342, 344, 346, 347, 349, 353, 355, 358, 359, 360, 367, 368, 369, 374, 378, 382, 383, 396, 400, 401, 457, 465, 509, 527, 1125, 1127, 2126, 2220, 2336, 2395, 2608, 2609, 3528, 3579
alluvial soils, 363
b-horizon, 323
bibliography, 165, 247
bulk density, 345
burning, 339
calcium, 209, 210, 281
clay content, 364
clay minerology, 238
crop productivity, 234
cultivation, 2442
degraded land, 393
distribution, 55, 107
east indies, 244
ecological impact, 427
ecosystems, 220
edaphic conditions, 397
evergreen forests, 253, 254
farm forestry, 300
felling, 383
fertilizers, 243
fires, 2608, 2609, 2620
foliar, 210
forest fires, 2600
forest types, 390
geology, 281, 390
growth, 190, 218, 223, 259, 323, 397, 2202, 3300, 3528, 3579
huay tak, 236
hydraulic conductivity, 527
increment, 364
India, 248, 279, 300, 314, 322, 340, 347, 352, 355, 359, 364, 369, 387, 401, 403, 2220
infiltration rate, 374
insect pests, 222
intercropping, 2395
irrigated plantations, 300
Java, 207, 208
Karnataka, 178, 227, 281, 332, 333
Kerala, 171, 172, 180, 182, 185, 186, 189, 194, 195, 197, 217, 218, 279, 347
konni teak plantations, 171
l.a.p luxmeter, 349
Laos, 95
laterisation, 260
laterite soil, 198
lateritic belt, 368
lateritic soil, 221
laterization, 253, 254, 261
leaves, 210
leucaena leucocephala, 2395

liberia, 242, 243
light intensity, 349
lime, 291
litter cover, 104
litter decomposition, 452, 465
loam soils, 273
Madhya Pradesh, 55, 211, 224, 240, 280, 321, 331, 355, 387, 388, 403, 2202
Mae huad teak plantation, 346, 378
Maharashtra, 237, 238
Malaysia, 173, 174
man made forests, 258
management, 2220
meghalaya, 232
mine restoration, 356
minerology, 240, 387
mixed cropping, 2336
mixed deciduous forest, 1125
mixed plantations, 197, 2126, 2442
moisture distribution, 273
monoculture plantation, 170, 194, 197, 310, 311
morphology, 305
mortality, 298
Myanmar, 201, 202, 215, 262
netherlands, 244
Nigeria, 166, 169, 245, 269, 308, 310, 311, 1127
nilambur, 162
nitrogen, 184, 191, 342
nutrients, 198, 203, 240, 248, 274, 310, 346, 401, 403, 427
organic carbon, 184, 191
organic matter, 342, 452
perlis, 247
plantation establishment, 95, 106
plantations, 175, 176, 180, 182, 184, 186, 195, 197, 203, 224, 225, 242, 253, 258, 261, 265, 273, 332, 333, 338, 352, 380, 393, 1127
podzolization, 253
potassium, 233
productivity, 169
rainfall, 259
regeneration, 262, 339, 1233
rehabilitation, 294
root penetration, 308
roots, 362
seasonal variation, 362
seed orchards, 265
seed origin, 2220
sikkim, 248
silvicultural systems, 360, 383
silviculture, 55, 457, 2126, 2220
site characteristics, 321
site classification, 400
site factors, 95, 106, 4111
site preparation, 347
site quality, 85, 172, 282, 301, 342
site selection, 107, 331
siwalik forest division, 353
slash burning, 217, 218, 339, 347, 1233
sloping land, 232
soil aggregate, 363
soil assessment, 247
soil chemistry, 220, 266, 294, 314, 322, 340, 344, 355, 367, 368, 369, 378
soil classification, 377
soil degradation, 237
soil erosion, 2336
soil fertility, 225, 352, 353
soil management, 2336
soil microorganisms, 452, 500
soil nutrients, 166, 242
soil organic matter, 189, 344
soil productivity, 388
soil survey, 173, 247
spatial distribution, 362
species composition, 178
species trials, 221
successive rotations, 190
taungya, 218, 2336
teak forests, 205, 211, 1125, 2620
thinning, 382
timber quality, 4111
undergrowth, 465
vam fungi, 509
vegetation types, 193, 199, 322, 357, 396
vegetation, 227, 339, 359
vertisol, 227
vesicular arbuscular mycorrhizae, 509
water conservation, 297
weed growth, 218
wood chemistry, 210

Soil survey
bibliography, 247
reforestation, 214
soil properties, 173, 247

Soil types
mixed plantations, 2381
seed germination, 1399
soil chemistry, 250

Soil water retention
infiltration, 292

Solar drying
seasoning, 4564

Solomon Islands
afforestation, 1839, 1959
Guadalcanal grasslands, 1839
plantation establishment, 1958, 1959
planting stock, 1958
provenance trials, 1012
seed collection, 1428
seed sources, 1428
silviculture, 1181, 2157
site index, 102
spacing, 2240
species trials, 2157
stump size, 1958
volume equations, 3445
wood properties, 4017

Somatic embryogenesis
tissue culture, 1734

Sono method
growth analysis, 3515

Sorghum bicolor
mixed cropping, 2421

Source variation
seed germination, 1450

South Africa
genetic improvement, 1008
plywood, 4661

South East Asia
distribution, 47, 107
grading, 4601, 4604
management, 2107
properties, 47
provenance trials, 933
scaling, 4604
silviculture, 2107
site selection, 107
soil properties, 107, 396
standardization, 4601
vegetation types, 396
wood properties, 4147

South India
vegetation, 1154

Southeast Asia
productivity, 3659
Sowing, 1389
afforestation, 1820
artificial regeneration, 1296, 1387
dibbling, 1528, 1530, 1579
fruit size, 1574
germination, 1474
nursery techniques, 1612
seed germination, 1417, 1508, 1579, 1612
seed rates, 1474
seed treatment, 1414, 1536
seedling growth, 1474
seedling production, 1612
seedling vigour, 1508
seeds, 1530
stump planting, 1820
stump quality, 1574
taungya plantations, 1414, 1536
transplanting, 1806, 1820
Spacing, 1978
biomass, 2180
crown diameter, 2214
diameter, 2138
fires, 1278
growth, 2224, 3440
increment, 2030
Indonesia, 2045, 2340
intercropping, 2045, 2340
intermediate fellings, 2512
Java, 2007
Kerala, 2254
litter, 456
litterfall, 2181
Nigeria, 1652, 2179, 2180
Nilambur plantations, 2254
nutrient contents, 2180, 2181
plantation techniques, 2007
plantations, 1970, 2030
regeneration, 1278, 2058
root activity, 2199
seed germination, 1655
seedling growth, 1652
seedling survival, 1655
silviculture, 3490
soil erosion, 524
Solomon Islands, 2240
species trials, 1278
stand density, 456, 2236, 3490
stem diameter, 2214
Tamil Nadu, 456, 2199
Tanzania, 2224
taungya system, 2045
teak forests, 2093
Thailand, 1278, 2236
thinning, 2093, 2138, 2171, 2512, 3490, 3553
timber quality, 2179
Tobago, 524
Trinidad, 524
Venezuela, 2512, 3553
wood density, 4223
yield, 2001, 2058, 2179, 2236, 3553
Spathodea campanulata
Hyblaea puera, 2805
Spatial distribution
roots, 362
Species association, 1061
Species composition
mixed plantations, 3506
shifting cultivation, 1893
soil properties, 178
Species diversity
ecological indicator, 128
ground flora, 119
Gujarat, 1158
India, 1134
Indonesia, 123
Java, 113
Karnataka, 134
Landolphia calabarica, 128
Lecaniodiscus cupanioides, 128
Madhya Pradesh, 116, 1160, 119, 120, 143
Maharashtra, 69
mixed plantations, 120
niche measurement, 1160
plantations, 69, 119, 142, 1134
pollination, 809
productivity, 119
regeneration, 1155, 143
species introduction, 1080
Sumatra, 113
teak forests, 1134, 116
Trinidad, 142
undergrowth, 123
understorey, 128, 138
Uttaranchal, 144
vegetation composition, 143
Species introduction
Africa, 1076
Brazil, 1107, 1108
British Commonwealth, 1139
Cameroons, 1126
exotics, 1094
Ivory Coast, 1109, 2160
Malaya, 1071
Meiji era, 1091
Nigeria, 1116, 1126
plantation establishment, 1107, 1108, 1109, 2160
savanna, 2160
silviculture, 1076, 1116
species diversity, 1080
Sudan, 1094
Togo, 1080
Tongo, 1082
United provinces, 1943
yield, 1116
Species selection
Java, 754
seed origin, 753
Thailand, 768
Species trials
afforestation, 1899
Amazon, 1120
Baikiaea plurijuga, 1896
Brazil, 1120, 1919
breeding, 27
Central America, 1146
copper belt, 1896
Costa Rica, 1146, 1929
Cuba, 27
degraded forests, 1932, 1963
factory effluents, 1885
fires, 1278
forestry research, 27
Ghana, 1814
grasslands, 1895
growth rate, 1141
lateritic soil, 221
Madelena project, 1146
Malaya, 1141
Philippines, 1932
plantations, 1267, 1919
rahuri, 1875
regeneration, 1278
saline soil, 1875
silviculture, 2157
soil properties, 221
Solomon Islands, 2157
spacing, 1278
Tamil Nadu, 1885
tannery effluent, 1885
Tanzania, 1899
teak forests, 1896
Thailand, 1278, 1963

Uganda, 1097, 1837
Venezuela, 1894
wildlife damage, 1896
Zambia, 1842, 1896

Specific gravity
bark, 4165
branches, 4166
carbon concentration, 4317
crushing strength, 4183
crushing stress, 4132
extractives, 4183
genetic variation, 860
Kerala, 860, 4164, 4165, 4166
lignin contents, 4183
selection criterion, 860
strength properties, 4269
timber quality, 860
weight, 4218
wood anatomy, 4131, 4132
wood density, 4317
wood properties, 4218
wood quality, 860

Spermoplane microflora
germinability, 1559

Spinning behaviour
Eutectona machaeralis, 3050

Split stumps
artificial regeneration, 1241
planting stock, 1606

Splitting coefficients
timber quality, 4266

Spodoptera litura
clonal resistance, 4507
feeding habits, 3057
Hyblaea puera, 3181
natural resistance, 3056
nuclear polyhedrosis virus, 3181
plus trees, 3056

Spore population
arbuscular mycorrhizae, 482

Sri Lanka, 3, 2130, 3560, 4447
agroforestry, 2439, 2440
breeding, 1039
community forestry, 2439
country reports, 23
farm forestry, 2344
forest policy, 1920
growth modelling, 3463
infiltration, 292
intercropping, 2440
management strategy, 2344
mixed plantations, 1172
nurseries, 2888
nursery practices, 1622
plantation forestry, 2130
plantations, 68, 911, 1920, 2183, 3828
productivity, 3561
provenance trials, 875, 911, 1039, 1040
reforestation, 292, 1537
seed germination, 1400, 1525
seed origin, 1927
seed treatment, 1525
silviculture, 1172, 1927, 3463
volume tables, 3828

Stains
decay resistance, 4548
furniture, 4718

Stand characteristics
genetic improvement, 970
Indonesia, 3792

Stand composition, 3504

Stand curve analysis
silvicultural characteristics, 1204

Stand density, 3370
botanical composition, 145
density management diagram, 3470
fertilisation, 2286
litter, 456
plantation variation, 1034
spacing, 456, 2236, 3490
thinning, 3490
yield prediction, 3470
yield, 2236

Stand development patterns
regeneration, 3378

Stand improvement
replanting, 2062

Stand management
Cote d'ivoire, 3825
timber quality, 2059

Stand tables
prodan's method, 3338
yield tables, 3518

Standardization
grading, 4601
vegetative propagation, 1769

Starch
seasonal distribution, 615

Statistical methods
provenance trials, 861

Statistics
cultivation, 3586
Nilambur plantations, 3672

Status report
Karnataka, 28
Kerala, 42
Tamil Nadu, 34

Stearamidomethylpyridinium chloride
dimensional stabilization, 4180

Stem analysis, 3577
klangdong teak plantation, 3537
wood anatomy, 4138

Stem borers
Xyleutes ceramica, 2908

Stem canker
Fusarium solani, 2697, 2727
Xyleborus similis, 2697

Stem cuttings
root formation, 1717
rooting, 1761, 1768

Stem diameter
spacing, 2214

Stem division
teak forests, 2557

Stem fusion
Indonesia, 680

Stem volume
plantation grown teak, 3336

Stemflow
hydrology, 545, 546, 547
throughfall, 58, 538, 545, 546, 547

Stereo radiographic technique
seed quality, 1487

Sterilisation
Hapalia machaeralis, 2829

Stock estimation
Kerala, 3375
yield, 3511

Stocking
Madhya Pradesh, 2536

Stomatal conductance, 684
leaf water potential, 638
shade, 638

Stomatal response
Nigeria, 716

Stomates

morphology, 685

Stony deposit
heartwood, 2577
Xyleutes ceramica, 2851

Storage
bud wood, 1721, 1722
carbon fixation, 3353
planting stock, 1644

Storage containers
seed storage, 1477

Storage technique
planting stumps, 1610
shoot cuttings, 1737

Strength properties, 3997, 4246
African grown teak, 4253
classification, 4602
cleavage properties, 4268
heartwood, 4244
mechanical tests, 4243
moisture content, 4245
plantation grown teak, 4148, 4254
review, 4247
sapwood, 4244
specific gravity, 4269
strength-moisture relationship, 4245
weathering resistance, 4294

Strength retention
wood decay, 4206

Strength-moisture relationship, 4245

Stress
creep, 4167

Stress relaxation
mechanical properties, 4155

Stress-strain behaviour
compressive strength, 4200
wood properties, 4202

Structural timber
buildings, 4575
wood properties, 4636

Stump analysis
growth rate, 3288, 3516

Stump diameter
breast height, 3529
dbh volume relation, 3409

Stump growth
tap roots, 1632

Stump malformation, 1607

Stump planting, 1235, 1617, 1890, 1979
afforestation, 1820
artificial regeneration, 1235, 1618
branching, 2069
ETP, 1297
growth, 1656, 2193
Ibadan fuel plantations, 3813
investments, 3813
Kanara plantations, 1848
mine restoration, 1924
natural regeneration, 1286
Nilambur, 2218
plantation raising, 1636, 2069
planting season, 2087
planting stock, 1608, 1618, 2085, 2086
pruning, 2069
reclamation, 1924
regeneration, 1618
root formation, 1673
root trainers, 1636, 1656
rooted stumps, 2193
rootless stumps, 2193
seedlings, 1656
silviculture, 1808
sloping land, 1907
stump size, 2089
stumps, 1656
transplanting, 1297, 1820
water conservation, 1907

Stump production
planting stock, 1627, 1628

Stump quality
fruit size, 1574

Stump size, 1643
age, 2089
plantation establishment, 1958
planting stock, 1958
seed size, 1556
stump planting, 2089
survival, 1604, 2246

Stump storage
planting stock, 1699, 2033
site factors, 97
survival, 1650

Stump transplanting
Kerala, 2188, 2189

Stump treatment, 1624

Stumpage value
growth, 3365

Stumps, 1714
age, 1649
artificial regeneration, 1241
containers, 1626
cuttings, 1620
fertilizers, 2285
growth, 1656, 1799, 2285
longitudinal splitting, 1605
mound layering, 1736
nursery period, 1649
nutrients, 375
planting period, 2219
planting stock, 1593, 1605, 1639, 1684
premonsoon planting, 2219
root trainers, 1656
seed quantity, 1593
seedlings, 1649, 1656
split stumps, 1241
stump planting, 1656
vegetative propagation, 1736
volumetric index, 3462

Sturmia inconspicuella
Hyblaea puera, 3143

Stylosanthes
underplanting, 2434

Succession
ecology, 1060
ground flora, 140
mixed plantations, 2400
sal, 82
understorey, 136
vegetation types, 1165

Successive rotations
soil properties, 190

Sucrose
chlorophyll synthesis, 660

Sudan
growth rate, 3341
harvesting, 2487
plantations, 1224
provenance trials, 968
root rot, 2738
silviculture, 2066
species introduction, 1094

Suitability indices
working properties, 4419

Sulphur accumulation, 2586

Sulphur dioxide
sulphur accumulation, 2586

Sulphuric acid

seed germination, 1402, 1552, 1558, 1561, 1592

Sumatra
species diversity, 113

Sumbawa
properties, 4189

Superheated steam
seasoning, 4545

Superior phenotypes
genetic improvement, 953

Surface treatment
furniture, 4408
sanding qualities, 4409

Survey
aerial photographs, 3263
Bihar, 472
diseases, 2559
India, 3255
Indonesia, 3236, 3237, 3238, 3259, 3266, 3685
insect pests, 2559
mapping, 3266
parasites, 472
Tamil Nadu, 3356
Thailand, 2559, 3243

Survival
field trials, 1689
genotypes, 1686
growth, 1650, 2246, 3495
planting stock, 1644
rooting, 1686, 1689
storage, 1644
stump size, 1604, 2246
stump storage, 1644, 1650
tissue culture, 1686, 1689

Sustainable agriculture
Trinidad and Tobago, 2360

Sustainable management
investments, 3783
Myanmar, 3781

Sustainable production
plantation establishment, 3760

Sustained yield
consortium support model, 3388
economics, 3725
investments, 3725, 3744
management, 3711, 3861
Myanmar, 3565
nutrient management, 2301
silvicultural management, 3851
timber production, 4774
yield regulation, 3565
yield, 3744

Sweden
allergy, 574
boundary layer conductance, 642

Swelling
moisture content, 4172
shrinkage, 4201, 4231, 4232, 4233

Swelling anisotropy
moisture content, 4172

Swelling pressure
plastic boards, 4704

Swelling properties
particle boards, 4673

Sylepta, 3137

Syleutes ceramicus, 2972

Symbiotic efficiency
arbuscular mycorrhizae, 508

Sympiesis
Eutectona machaeralis, 3090
Hyblaea puera, 3090
natural enemies, 3090

Sympiesis hyblaea
biological control, 3193
Hyblaea puera, 3192, 3193, 3194

Synecology, 1150, 1156, 1157
floristic composition, 124
regeneration, 1159

Synthetic teak, 4063

Syntomernus
Asphondylia tectonae, 3180

Taiwan
growth, 111, 3439
laminated wood, 4335
marketing, 3914
mechanical properties, 4295
tannin, 580
weathering resistance, 4294
yield prediction, 3411

Tamarindus indica
interplanting, 2385

Tamil Nadu
age, 1649
agri silviculture, 2438
agroforestry, 2352
agrosilvicultural systems, 3785
allozyme diversity, 950
artificial regeneration, 1235, 1381
clonal identification, 782
cultivation, 2447
economic analysis, 3785
economics, 2447
factory effluents, 1885
farm forestry, 300, 2447
fertilizers, 270
flora, 555, 557
genetic improvement, 855, 880
genetic variation, 950
giant timber, 3564
growth substances, 1789
growth, 259
interception, 58
intercropping, 2438
investments, 3751
irrigated plantations, 300, 2289
isoenzymes, 782
litter, 456, 458
management, 3801
micronutrients, 2298
mortality, 2105
natural regeneration, 1286, 1347
nurseries, 1628
nursery period, 1649
nutrient return, 458
phenological behaviour, 655
plant density, 2105
plant invasions, 118
plantation raising, 1889
plantation schemes, 3751
plantation techniques, 2217
plantations, 225, 270, 2636
planting, 1954
planting stock, 1789
plus trees, 1024
productivity, 2289, 2352
provenance trials, 1024
pruning, 1982
rainfall, 58, 252, 259
regeneration, 1381
root activity, 2199
seed orchards, 880
seedling growth, 1789, 2298
silviculture, 360, 1168
soil chemistry, 252, 322

soil fertility, 225, 270
soil properties, 225, 259, 300, 322, 359, 360, 509
spacing, 456, 2199
species trials, 1885
stand density, 456
status report, 34
stemflow, 58
stump planting, 1235, 1286, 1890
stump production, 1628
stumps, 1649
survey, 3356
tannery effluent, 1885
teak forests, 1347, 3801
teak improvement, 1024
thinning, 2124, 2125
throughfall, 58
timber price, 2483
tissue culture, 1024
underplanting, 2327, 2466
vam fungi, 509
vegetation communities, 1164
vegetation, 252, 322, 359
vesicular arbuscular mycorrhizae, 509
weed growth, 2636
Western Ghats, 118, 360, 1164

Tanga region
forestry plantations, 2256

Tanganyika
cultivation, 1851
investments, 3749

Tannery effluent
species trials, 1885

Tannin, 580
leaves, 575

Tanzania
afforestation, 1899
allozyme diversity, 950
antelope habitat, 2678
breeding, 806, 967, 1032
cutting methods, 2227
decay, 4067
environmental impact, 75
Fusarium solani, 2727
genetic improvement, 967, 996
genetic variation, 779, 780, 950
grafting, 806
growth, 2044, 2224
habitat use, 2679
Helicobasidium compactum, 2730
introduced species, 1123
isozyme variation, 779
Kilombero valley teak company, 3620
mammals, 153
management, 1870
marketing, 3620
mating system, 780
mechanical properties, 4171
pink disease, 2727
plantation establishment, 75
plantation grown teak, 4171
plantations, 153
planting, 2257
pollination, 996
productivity, 2227, 3417
progeny testing, 806
progeny trials, 996, 1032
provenance trials, 968, 976, 997, 1031
quality assessment, 4067
root rot, 2730
site index, 3417
soil properties, 219
spacing, 2224
species trials, 1899
stem canker, 2727
thinning, 2227
timber trade, 3620
volume tables, 3280
weeding, 2044, 2203
wildlife habitat, 153, 2679

Tap roots
stump growth, 1632

Taungya
agroforestry, 2351, 2374, 2413, 2433, 2453, 2456, 2458, 2477
Burma, 2359, 2484
cash crops, 2413
cultivation, 2338, 2458
Darjeeling Himalaya, 2450
ecosystems, 2450
felling, 2484
growth, 218, 2362
Indonesia, 2433, 2456, 2458
intercropping, 2413, 2458, 2473
interplanting, 2385
Java, 2338, 2361
Kerala, 218
kumri crops, 2330
mixed cropping, 2328, 2330, 2336, 2472
mixed planting, 1257
Myanmar, 1257, 1258, 2351, 2405, 2477
natural regeneration, 2392
oil seeds, 2413
plantations, 2481
reforestation, 2453, 2460
regeneration, 1257, 1258, 1320, 2326, 2484
seed treatment, 1536
slash burning, 218
social forestry, 2460
socio economics, 2433
soil erosion, 2336
soil management, 2336
soil properties, 218, 2336
sowing, 1536
Tamarindus indica, 2385
taungya, 2399
Thailand, 2374, 2385, 2472
underplanting, 2338
weed growth, 218
West Bengal, 2399, 2450

Taungya crops
Indonesia, 141
medicinal plants, 141

Taungya plantations
agroforestry, 2337
sowing, 1414

Taungya system
Burma, 2350
forest management, 2349
Indonesia, 2045
intercropping, 2045, 2347
Java, 2342, 2343
Myanmar, 2349, 2350
regeneration, 2350
shifting cultivation, 2350
silviculture, 2335
spacing, 2045
Thailand, 2347
Turrialba, 2335

Teak forests
age, 1813, 2229, 2532
Andhra Pradesh, 1207, 3767
Baikiaea plurijuga, 1896
biodiversity, 132
birds, 160
bismarck-archipelago, 1056
Biza orellana, 2383
bori reserve, 2571
breeding, 1997

burning, 2053
Canada, 156
copper belt, 1896
coppice system, 2233
Cuba, 101
cultivation, 1886
cutting cycle, 2503
damascsche, 3653
Danish Thai Teak Improvement Centre, 1225
distribution, 1135
ecology, 1132
economic returns, 1096
elephant habitat, 156
establishment costs, 3739
evergreen forests, 1117
FAO, 769
felling, 1273
fire protection, 2571, 2611, 2623, 2624
fires, 1228, 2607, 2617, 2620
flowering, 1131
genetic improvement, 769, 1225
grazing, 2683, 2686
green manures, 2370
growth rate, 3609
Gujarat, 71
hand cart, 2508
harvesting, 2490, 2542
history, 101
Imperata cylindrica, 2637
India, 1130, 1131, 1132, 1134, 1137
Indonesia, 160, 205, 1053, 1136, 1997, 2012, 2057, 2496, 2508, 2522, 2542, 3670, 3739, 3798, 3809, 3862
interplanting, 2370
inventory, 3262
investments, 1096, 3791, 3809
Java, 1057, 1069, 1115, 2016, 2017, 2019, 2061, 2503, 2506, 2532, 3585
Kerala, 551
Laos, 1147
Madhya Pradesh, 116, 211, 1112, 1135, 1143, 1210, 2195, 2233, 3232
Maharashtra, 1335, 2570, 3790
Malaya, 1133
Malaysia, 156
man made forests, 1997
management, 1210, 2037, 2039, 2233, 3790, 3798, 3801, 3807, 3823, 3826
mixed deciduous forest, 1125
Myanmar, 1121, 1129, 1138, 2611, 2623, 2624, 3548, 3631, 3776, 3794, 4395
natural regeneration, 1273, 1347, 1364, 1385, 2233
natural succession, 1143
New Guinea, 3637
New Zealand, 156
Nigeria, 3733
origin, 778
physiology, 1132
plantations, 1134, 2053
productivity, 1131
railways, 2506, 2522
Rajasthan, 1104, 1105, 1106
regeneration, 1143, 1207, 1263, 1335, 1360, 1361, 1365, 2233, 4395
reproduction, 1228
review, 1130
roads, 2506
rotation, 2016, 2019, 2054, 2055, 2057, 2060, 2061, 2232
seed germination, 1131, 1228
seedlings, 1896
Siam, 3799
silvicultural techniques, 2017
silviculture, 1210, 1214, 1225, 1360
site quality, 3609
soil properties, 205, 211, 1125, 2620
spacing, 2093
species diversity, 116, 1134
species trials, 1896
stem division, 2557
Tamil Nadu, 1347, 3801
Thailand, 769, 1083, 1103, 1124, 1125, 1214, 1225, 1273, 2490, 3494, 3608, 3609, 3856
Thana, 1335
thinning, 2012, 2093, 2195, 2231
Togo, 769, 3735
trade, 2057
transportation, 2508
Trinidad, 3731, 3732
tropical forestry, 1096
undergrowth, 2383
utilisation, 2496
vegetation types, 1112
wildlife damage, 1896
yield, 2054, 2055, 2542, 3494, 3548
Zambia, 1896

Teak improvement
breeding, 862
India, 1024
provenance trials, 1024
Tamil Nadu, 1024
Thailand, 862
tissue culture, 1024

Teak Improvement Centre
genetic improvement, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 1030
Mac huat teak plantations, 1030
nursery practices, 1616
Thailand, 842, 1616

Teak oil
medicinal properties, 4741, 4748
Methylanthra quinone, 4758
review, 4316

Teak plantation
India, 391

Teak Research Institute, 4777

Teak stands
volume tables, 3575

Teak Sub Commission
India, 4770
Indonesia, 4772

TEAKNET, 16

Technology
seminar proceedings, 3347

Technology transfer
small dimensional timbers, 4394

Tectograndone
anthraquinone
naphthoquinone, 568

Tectoleafquinone
colouring matter, 567

Tectols
chemical properties, 4365

Tectoquinone

chemical composition, 569
chemical properties, 4305, 4353
durability, 4511
insecticides, 4353
optical properties, 4237
termite resistance, 4531
wood chemistry, 4325
wood colour, 4237
wood properties, 4054

Tekkadi
giant timber, 3357

Teleonemia scrupulosa
defoliation, 2898

Temperature
natural forests, 77
Neotermes tectonae, 2806
plantations, 66, 77
tools, 2529

Tending
weeds, 1990

Tephrosia cinerea
insecticides, 3218

Tephrosia noctiflora
insecticides, 3218

Teredo parksi, 2827

Terminology, 4217

Termite aided mesocarp removal
seed germination, 1423

Termite damage
Cryptotermes brevis, 3227
Heterotermes tenuis, 3227
Nasutitermes costalis, 3227

Termite repellents, 3226, 3228

Termite resistance, 4461, 4528
anthraquinones, 4516
chemical control, 4537
chemical properties, 4358
durability, 4527
Microcerotermes beesoni, 4524, 4525
tectoquinone, 4531

Termites
Amitermes evuncifer, 3060
Australia, 2875
Bangladesh, 2862
Microcerotermes, 3060
Microtermes, 3060
Pakistan, 2862
soil fertility, 492
wood extractives, 2811

Tetrastichus
parasites, 3153

Thai Danish Teak Improvement Centre
genetic improvement, 903, 904

Thailand
acid deposition, 74
acid treatment, 1429, 1432, 1481, 1497, 1499, 1561, 1592
afforestation, 1815
age effect, 3460, 4224
age, 283, 715, 1489, 1492, 1663, 3479
agroforestry, 2374, 2375, 2387
agrosilvicultural systems, 2464
allozyme diversity, 950
anatomy, 689, 2586
annual increment, 3556
b-horizon, 323
Bacillus thuringiensis, 2903
bark thickness, 3517
barkwood, 4118
basal area, 3479
Beauveria bassiana, 2901
beehole borer, 2901, 2902
bibliography, 18
biodiversity, 2375
biological control, 2901, 2917, 3155
biomass, 375
biomass production, 3461
branches, 3538
breast height, 3517, 3529
breeding, 740, 743, 762, 767, 770, 785, 862, 863, 930
breeding programmes, 752
bud grafting, 1788
budding, 1713, 1773
buttress height, 3315
calcium carbonate, 1551
chemical composition, 468
chemical control, 2207
chemical properties, 379
chromosome, 792
classification, 4609
climate, 729
commercial timbers, 4065
control, 2903
coppicing, 1374, 2207
cost benefit analysis, 2127
country reports, 22, 29, 36, 48, 3684
cross grain, 4286
crown spreads, 3396
crown widths, 3460
Danida Forest Seed Centre, 949
Danish Thai Teak Improvement Centre, 1225
DBH measurement, 3447
decay resistance, 4460
defoliation, 2917
degraded forests, 1963
dendrochronology, 729, 730, 731, 732
dendroclimatology, 732
diameter at breast height, 3315
diameter, 3517
diameter estimation, 3527
Dihammus cervinus, 2907
diseases, 2559
distribution, 3460
economics, 2127, 2464, 2547, 3759
environmental impact, 1913
erosion, 525
establishment period, 1876
Euctona machaeralis, 2958
exports, 3901, 3938
extractives, 4351
factories, 3956
FAO, 769, 3619
farm forestry, 2415
felling, 383, 1273
fertilization, 1415, 2323
fertilizers, 2267
fire damage, 2596
fires, 543, 1278, 2608, 2609
floral biology, 826, 827
flowering, 762, 930
flowers, 657
forest law, 2550
forest village programme, 2387
form quotient, 4046
fruit production, 810, 826
gamma radiation, 3544
gamma ray irradiation, 1482
gene diversity, 937
genecological zonation, 1022
genetic conservation, 894, 1022

genetic diversity, 869
genetic improvement, 769, 770, 771, 784, 842, 847, 852, 853, 863, 902, 903, 938, 940, 942, 944, 945, 1025, 1042, 1225, 1590
genetic inheritance, 762
genetic resources, 1025
genetic variation, 779, 780, 781, 950, 955
germination medium, 1555
gibberellic acid, 1663, 1664, 1669, 1702
girth measurement, 3304
gold, 4303
grading rules, 4606
grading, 4572
growth analysis, 3515
growth performance, 1799, 3311
growth rate, 3516, 3609
growth rings, 689, 729, 731
growth, 223, 323, 324, 336, 337, 735, 848, 1650, 1669, 1702, 2192, 2193, 2239, 2246, 2478, 3299, 3321, 3382, 3464, 3495, 3498, 3513, 3528, 3536, 3544, 3555, 3556, 3579
hardboards, 4693
harvesting, 375, 2490, 2547
heartwood development, 1367
heartwood, 3555
heat treatment, 1491
height, 373
herbicides, 2207
huay tak, 236
Hyblaea puera, 2903, 2958
hydrochloric acid, 1481, 1497
hydrology, 61, 525, 541
illegal cutting, 2526, 2550, 2552
increment borer, 3556
increment, 2010, 3465
industry, 3955, 3958
insect pests, 222, 2559, 2917, 2918
instruments, 3447
intercropping, 2347, 2464
international cooperation, 928
international effort, 949
interplanting, 2385, 2478
inventory, 3229, 3242, 3244, 3245, 3246
investments, 3724, 3757, 3793
isoenzymes, 818
isozyme analysis, 937
isozyme variation, 779
keen's method, 4609
klangdong teak plantation, 3537
Lampang teak plantations, 110
leaf weight, 715
leaves, 74
light, 1540
litter decomposition, 465, 468
log volume, 395
logging, 2545
Mae huad teak plantation, 336, 337, 346, 373, 378, 379
Mae ngao forest, 3817
management, 1185, 2013, 2108, 2239, 2918, 3610, 3649, 3690, 3836
marketing, 1283, 3913, 3956
mating system, 780
mechanical properties, 4281, 4286, 4288
micro fungi, 495
micropropagation, 1706
mixed cropping, 2472
mixed deciduous forest, 1125
moisture metre, 4225
multivariate study, 781
natural forests, 77
natural regeneration, 1273, 1311
nitrogen, 342
nurseries, 2735
nursery practices, 1616, 1640
nursery techniques, 1611
nutrients, 346, 375, 468
organic matter, 342
outcrossing rate, 818
particle boards, 4691
pathology, 2704
physical properties, 4077, 4288
plantation development, 3155
plantation establishment, 2050, 2239, 3155
plantation grown teak, 4287
plantation techniques, 2111
plantations, 77, 317, 1202, 2228
planting stock, 1699, 1788, 2033
plus trees, 955
pollen, 828
pollination, 816, 818, 825, 826, 827, 828
private forestry, 1873
productivity, 3389, 3394, 3467
progeny testing, 1026
propagation, 740, 1715
properties, 4004
provenance research, 902
provenance trials, 848, 849, 928, 935, 941, 949, 955, 998, 1027
quality seeds, 945
rainfall, 61, 735
random amplified polymorphic DNA markers, 869
reforestation, 784, 1590, 1891, 1913
regeneration, 1202, 1278, 1283, 1326
research, 2239
resources, 3493
rooted stumps, 2193
rootless stumps, 2193
roots, 3460
rotation, 2127
sapwood, 3517
seasonal variation, 724
seed characteristics, 1602
seed collection, 1452, 1603
seed germination, 930, 1411, 1415, 1416, 1417, 1420, 1426, 1429, 1432, 1434, 1481, 1482, 1489, 1491, 1492, 1497, 1499, 1532, 1533, 1538, 1540, 1548, 1551, 1555, 1558, 1561, 1569, 1570, 1571, 1573, 1575, 1591, 1592, 2239
seed orchards, 810, 863, 929, 993, 1410, 1416
seed processing, 1550
seed production, 828, 1590
seed situation, 1567
seed size, 1532, 1556
seed storage, 1410, 1570, 1572, 1591
seed treatment, 1410, 1533, 1540, 2239
seedling diseases, 2735

seedling growth, 1663, 1664
seedling survival, 1492, 1667
seedling vigour, 510, 1492
seedlings, 510
selective logging, 2511
shade, 1667
silvicultural systems, 383
silviculture, 1182, 1185, 1202, 1214, 1225, 2013, 2108, 2150, 2239
site factors, 99, 105
site index, 105
site quality, 85, 110, 282, 324, 342, 3609, 4046
smuggling, 2549
soaking, 1426, 1558, 1561, 1571, 1575
social forestry, 1873, 3724
soil aggregate, 324
soil chemistry, 378
soil depth, 336, 337, 373, 395
soil erosion, 543
soil fertility, 213, 289
soil fungi, 495
soil moisture, 317
soil nutrients, 379
soil organic matter, 379
soil properties, 85, 212, 222, 223, 236, 277, 282, 283, 323, 342, 346, 378, 382, 383, 465, 1125, 2608, 2609, 3528, 3579
sono method, 3515
sowing, 1417
spacing, 1278, 2236
species selection, 768
species trials, 1278, 1963
stand density, 2236
stem analysis, 3537, 3577, 4138
stump analysis, 3516
stump diameter, 3529
stump planting, 2193
stump size, 1556, 2246
stump storage, 1650, 1699, 2033
stumps, 375, 1714, 1799
sulphur accumulation, 2586
sulphur dioxide, 2586
sulphuric acid, 1558, 1561, 1592
survey, 2559, 3243
survival, 1650, 2246, 3495
Tamarindus indica, 2385
taungya system, 2347
taungya, 2374, 2385, 2472
teak forests, 769, 1083, 1103, 1124, 1125, 1214, 1225, 1273, 2490, 3494, 3608, 3609, 3856
Teak improvement centre, 842, 1616
teak improvement, 862
temperature, 77
Thai Danish Teak Improvement Centre, 903
thinning, 382, 1374, 2010, 2120, 2175, 2192, 2228, 3461, 4648
timber hardness, 4224
timber production, 2111, 3272
timber quality, 849
tissue culture, 1677
topography, 3528
trade, 3870, 3871, 3873, 3876, 3895, 3896, 3898, 3901, 3929
tree size, 1434
undergrowth, 465
utilisation, 4001, 4066
vam fungi, 510
vegetative propagation, 928, 1772, 1773
veneer, 4606
vesicular arbuscular mycorrhizae, 510
viability, 828
volume, 3320
volume determination, 3538
volume tables, 3303, 3380, 3391
watershed management, 541
weeding, 2194
wood anatomy, 724, 730, 731, 732, 4077, 4138
wood chemistry, 4303, 4351
wood destroying beetle, 2810
wood formation, 724
wood properties, 4001, 4033, 4050, 4065, 4066, 4287, 4288
working plan, 3817
Xyleutes ceramica, 2901, 2907
yield, 105, 848, 849, 2150, 2236, 2511, 3316, 3494, 3722

Thana malki
working plan, 3847

Thana
regeneration, 1335

Thatching
West Bengal, 4724

Thenmala forest division
harvesting, 2538

Thermal conductivity
microwave radiation, 4220

Thermal decomposition, 4436

Thermal properties, 4207, 4434

Thiamine
vegetative propagation, 1676

Thickness
heartwood, 3334
sapwood, 3334

Thinned wood
housing, 4540
preservative treatment, 4540
utilisation, 4646

Thinning
alignment chart, 3234
Betul division, 2221
biomass production, 3461
bole diameter, 3401, 3533
coppice crop, 2182
coppice, 2064, 2221
coppice stands, 2197
coppicing, 1374
crown diameter, 3401
crown projection, 3533
cutting methods, 2227
diameter, 2138
energy consumption, 2168
fertilization, 2041
growth, 2041, 2192, 3542
growth modelling, 3581
growth rate, 2116
height-diameter relationship, 3581
increment, 2010
intermediate fellings, 2512
Mong mit forest division, 1246
mortality, 2561
natural regeneration, 1246
Nilambur plantations, 1981, 1983, 2003, 2112, 2253
paper making, 2184
planning, 2152
plantation grown teak, 2152
plantation techniques, 2212

plantations, 2026, 2128, 2129, 2178, 2215, 2222, 2223, 2228, 2245, 2248
productivity, 1993, 2186, 2227
regeneration, 2213
research, 2245
root competition, 2250
seasoning, 3973
shaping, 2152
single stem silviculture, 2209, 2210, 2211, 2212, 2221, 2226
spacing, 2093, 2138, 2171, 2512, 3490, 3553
stand density, 3490
teak forests, 2012, 2093, 2195, 2231
tending, 1990
undercrops, 3420
underplanting, 2462
understorey, 3615
utilisation, 4637
weeds, 1990
working plan, 3615
yield, 2026, 3553
yield tables, 2032, 3360

Thinning intensity
growth, 2173

Thinning knife, 2036

Thinning materials
mechanical properties, 4251
physical properties, 4251

Thinning practice
plantations, 2176

Thinning trials
Nigeria, 2000

Throughfall
hydrology, 545, 546, 547
interception, 58
rainfall, 58, 538
stemflow, 58, 538, 545, 546, 547
Tropical dry deciduous forest, 547

Timber certification, 4579

Timber classification, 4593

Timber connectors
working stress, 4298

Timber hardness
age effect, 4221, 4224

Timber loss
wood defects, 3361

Timber measurements, 3292, 3293
rafting, 3273

Timber price
Tamil Nadu, 2483

Timber production
exports, 3965
fertigation, 2274
fertilizer trials, 2274
Indonesia, 3643
intensively managed plantation, 3298
Java, 3965
logging, 3643
Myanmar, 3271
plantation techniques, 2111
silvicultural treatments, 2274
sustained yield, 4774
Thailand, 2111, 3272

Timber quality
age, 728
America, 4160
breeding, 794
Burma, 4235
climate, 4002
Costa Rica, 2205, 4003
decorative properties, 794
exports, 1176, 4041
fast grown timber, 3980, 3981, 3982, 3983, 3989, 3998, 4003, 4037
felling system, 2539
France, 4293
genetic improvement, 794, 4011
genetic variation, 860
girdling, 2499
growth periodicity, 728
growth rate, 3322, 4213
growth, 794
harvesting, 2499
Indonesia, 794, 2539
investments, 3629, 4032
irrigation, 728
juvenile wood, 3983, 4163
Kerala, 728, 860, 3627, 4084, 4088
Malaya, 4151
Malaysia, 4611
management, 3627
moisture absorption, 4160
Myanmar, 4041
Netherlands, 3629
Nigeria, 2179
plantation grown teak, 4047, 4080, 4084, 4088, 4182, 4611
policy, 3998
provenance trials, 849
selection criterion, 860
silviculture, 4032
soil properties, 4111
spacing, 2179
specific gravity, 860
splitting coefficients, 4266
stand management, 2059
Thailand, 849
understorey, 3986
utilisation, 4009
Venezuela, 2585
wood defects, 2585
wood properties, 4235
wood quality, 860
wood structure, 728
yield, 849, 2179

Timber size, 3558

Timber substitutes, 4064

Timber trade
imports, 3885
Kilombero valley teak company, 3620
prices, 3885
Tanzania, 3620

Timbers
World, 4052

Tirfor
felling, 2518, 2548

Tissue culture
adventitious rhizogenesis, 1783
clonal multiplication, 1710, 1787
clones, 1692
cloning, 1701
Cuba, 1767
field performance, 1692
field trials, 1689
genotypes, 1686
growth, 1732
India, 1024
Indonesia, 1793
Karnataka, 1787
Maharashtra, 1734
Malaysia, 1753
micropropagation, 1705, 1709, 1730, 1757, 1783
morphogenesis, 1697

planting stock, 1801
plus trees, 1024, 1701
pollen, 1683
productivity, 1760
progeny testing, 1024
propagation, 1730
propagule production, 1725
provenance trials, 1024
random amplified polymorphic DNA markers, 1705
rooting, 1686, 1689
seed germination, 1683
shoot production, 1709
somatic embryogenesis, 1734
survival, 1686, 1689
Tamil Nadu, 1024
teak improvement, 1024
Thailand, 1677
vegetative propagation, 1753, 1762, 1767
West Bengal, 1701

Tissue culture protocols
vegetative propagation, 1707

Tissue cultured plants
field trials, 1743, 2262, 2263

TIV plantations
management, 2024

Tobago
country reports, 45
diseases, 2760
planting, 1190, 1191
provenance trials, 968
silviculture, 2156
soil erosion, 524
spacing, 524
thinning, 2167, 4637
underplanting, 1190
utilisation, 4637

Togo
afforestation, 1840
country reports, 29
dris evaluation, 88
economics, 3652
FAO, 769
forest policy, 1840
genetic improvement, 769
investments, 3779
reforestation, 214
silviculture, 3779
site quality, 88
soil survey, 214
species diversity, 1080
species introduction, 1080
teak forests, 769, 3735
yield, 88, 3779

Togoland
afforestation, 1272
plantations, 1977

Tongo
species introduction, 1082

Tools, 2529

Topography
soil properties, 3528

Torsional properties, 4274

Tortrix
defoliation, 2789

Toxicants
sawdust, 599

Toxicity
extracts, 587

Trade, 3966
Burma, 3909, 3910
East India company, 3892
economics, 3905, 3927
exports, 3901
France, 3875
India, 3868, 3869, 3923, 3934
Indonesia, 2057, 3902, 3922
Java, 3922
marketing, 3937
Myanmar, 3905, 3926, 4005
Netherlands, 3878
prices, 3903
rotation, 2057
Siam, 3872, 3887, 3890, 3891, 3912, 3926, 3941
teak forests, 2057
Thailand, 3870, 3871, 3873, 3876, 3895, 3896, 3898, 3901, 3929
trade, 3922

Transmission poles
India, 4643

Transpiration
water stress, 540

Transplanting
container seedlings, 1645
ETP, 1297
sowing, 1806, 1820
stump planting, 1297, 1820

Transportation
floating, 2537
hand cart, 2508
harvesting, 2523
Indonesia, 2488, 2508, 4764
Java, 2488
logging, 2523
Madhya Pradesh, 2528
teak forests, 2508

Travancore
giant timber, 550
Kerala, 550, 1049, 2189
leaf morphology, 1049
seed germination, 1049
stump transplanting, 2188, 2189
working plans, 3639

Travancore teak plantations, 3700

Tree age
seed germination, 1524

Tree breeding
provenance trials, 756

Tree dust
allergy, 603

Tree health, 2567

Tree height
Hyblaea puera, 3031
Trichogramma chilonis, 3031

Tree size
seed germination, 1434

Tree volume
basal area, 3525
nutrient concentration, 3525

Trenching
plantations, 534

Tribolium castaneum
shot-holing, 3134

Trichogramma
Hyblaea puera, 3095
Pyrausta machaeralis, 3175, 3176

Trichogramma chilonis
Hyblaea puera, 3030, 3031, 3178

Trinidad
breeding, 749
budding, 749
country reports, 45
diseases, 2760
fires, 2612
growth rate, 3339, 3428
mechanical properties, 4285
mistletoe, 2641
physical properties, 4285

plantation establishment, 1266, 1931
plantation raising, 1052, 2025
plantations, 39, 142, 1261, 2154
planting, 1190, 1191
provenance trials, 968
pure teak plantation, 2042
rates, 3766
regeneration, 1931
royalty, 3766
silviculture, 1197, 1223, 2134, 2156
soil erosion, 524
spacing, 524
species diversity, 142
teak forests, 3731, 3732
thinned wood, 4646
thinning, 2167, 4637
underplanting, 1190
utilisation, 2134, 4637, 4646
vegetative propagation, 749
yield tables, 1261, 3425

Trinidad and Tobago
durability, 4465
exotic trials, 2401
hysteresis properties, 4184
inventory, 3235
investments, 2401
management, 3829
plantations, 3644
production, 2360
sustainable agriculture, 2360
wood properties, 4184

Tripura
biomass production, 3328
crop productivity, 234
potassium, 233
seed treatment, 1600
soil properties, 233, 234

Triterpene acid
cell culture, 4330

Tritirachium
litter decomposition, 454

Trivandrum Forest Division
soil properties, 183

Tropical dry deciduous forests
hydrology, 547

Tropical forestry
investments, 1096
teak forests, 1096

Tropical woods
marketing, 3930

Trunk damage
branch tearing, 2587

Trunk diameter
microwave radiation, 3541

Trunk injection
chemical control, 2632, 2648
mistletoe, 2632, 2648

Tuberculosis
medicinal properties, 4749

Tucktoo
beehole borer, 3120

Tumpangsari method
plantation establishment, 1877

Turmeric
intercropping, 2397

Turrialba
taungya system, 2335

Udonga montana
Wayanad, 3036

Uganda
seed processing, 1550
species trials, 1097, 1837
wood properties, 4029

Ultra-violet light
chromatographic investigations, 4055

Uncinula tectonae
fungus diseases, 2714
leaves, 2770, 2784

Undercrops
agroforestry, 2426, 2436
cash crops, 2436
thinning, 3420
vanalakshmi, 2426

Undergrowth
age, 123
biological control, 3136, 3154
Biza orellana, 2383
defoliation, 3154
defoliators, 3136
Indonesia, 123
Java, 126
litter decomposition, 465
parasites, 2897
soil properties, 465
species diversity, 123
teak forests, 2383
Thailand, 465

Underplanting
Artocarpus hirsuta, 2462
cultivation, 2338
growth, 2334
Indonesia, 130
Java, 2338
Karnataka, 2396
Kerala, 2459
Lucaena, 117
Lucaena glauca, 2348
Madhya Pradesh, 2434
management, 3591
medicinal plants, 130
Nilambur plantations, 2409
plantations, 117
planting, 1190
Puerto Rico, 3591
reed, 2459
seed orchards, 2434
soil conservation, 2459
Stylosanthes, 2434
Tamil Nadu, 2327, 2466
taungya, 2338
thinning, 2462
Tobago, 1190
Trinidad, 1190
weed control, 2434

Understorey
Africa, 127
Benin, 127
biotope, 128
Costa Rica, 137
defoliation, 3160
ecological indicator, 128
ecotones, 137
forest floor, 146
France, 128
grass, 112
Hyblaea puera, 3160
Indonesia, 114, 131, 3615, 4744
Java, 115
Landolphia calabarica, 128
Lecaniodiscus cupanioides, 128
medicinal plants, 131, 4744
Pavonia odorata, 3160
Pavonia zeylanica, 3160
plantations, 112, 139
species diversity, 128, 138
succession, 136
thinning, 3615
timber quality, 3986
Uttaranchal, 136
working plan, 3615

United Kingdom
grading rules, 4584

United provinces
mixed plantations, 1070
regeneration, 1110
species introduction, 1943

United States
machine, 4205

Urea lime treatment
litter decomposition, 410

Uredo tectonae
diseases, 2736
leaf rust, 2783

Uredospore
rust, 2745

Uroplata girardi
weed control, 2911

Utilisation
Africa, 44
branches, 4639
British India, 3557
Burma, 3968
construction, 4618
Damasces, 4620
decking, 4659
East Indies, 3557
Ecuador, 3957
Europe, 3874
extractives, 4383
Ghana, 44
grading, 4603
India, 4000, 4650, 4651, 4654, 4655, 4656
Indonesia, 2496, 4630
industry, 3874, 3957
Kerala, 14, 4640
marine trials, 4649
Myanmar, 2134, 4621
Netherlands, 3557
Nigeria, 4644
ornamental timbers, 4621
Papua and New Guinea, 3975
poles, 4625
processing, 44, 4644
properties, 2467, 3968, 3970, 3975, 3977, 4649
resources, 4641
Siam, 3557
teak forests, 2496
Thailand, 4001, 4066
thinned wood, 4646
timber quality, 4009
Tobago, 4637
Trinidad, 2134, 4637, 4646
West Bengal, 3999
wood chemistry, 4113
wood properties, 4001, 4007, 4061, 4066, 4154, 4212, 4216, 4383, 4600, 4645, 4657

Uttar Pradesh
alluvial soils, 363
biochemical cycling, 439
biomass, 656, 3385, 3444
biomass estimation, 3443
biomass production, 276
botanical composition, 83
carbohydrate content, 656
carbohydrates, 313
carbon, 361
chemical composition, 613
clay minerals, 200
coppice, 1232
coppice shoots, 1006
flora, 561
foliar constituents, 613
genetic improvement, 1017
genetic variation, 744
Geographical information system, 3486
growth, 330
hydrology, 548
infiltration rate, 374
intercropping, 2414
leaves, 423, 437, 460, 613
litter, 422, 437, 439, 459
litter cover, 104
litter decomposition, 275, 423, 438, 460, 462
mechanical properties, 4159
mistletoe, 2635
nematodes, 515
nursery diseases, 2747
nutrient concentration, 459
nutrient conservation, 439
nutrient distribution, 3444
nutrient dynamics, 644
nutrient return, 422
nutrients, 274, 361, 438, 604
Paralongidorus sali, 515
phorophyte, 2635
physical properties, 4159
plantations, 229, 1186
plus trees, 1033
productivity, 3443
rainfall, 272
regeneration, 52, 1232
remote sensing, 3486
reproduction, 644
resource assessment, 3486
root formation, 1717
root growth, 659
rooting, 1740
roots, 656
seasonal variation, 313
seed germination, 1554
seed orchards, 796, 1006
seed production, 796
seed treatment, 1554
seedlings, 604, 1232
silicon, 200
silviculture, 2092
Siwalik forest division, 353
sodic soils, 330
soil aggregate, 363
soil chemistry, 200, 271, 276, 361, 548
soil fertility, 353
soil moisture, 229, 272, 275
soil organic matter, 271
soil properties, 104, 274, 353, 363, 374
stem cuttings, 1717
synecology, 1156
underplanting, 2449
vegetation, 52
vegetative propagation, 1717, 1740
yield, 1186

Uttaranchal
ecology, 693
forest ecosystems, 1346
leaves, 693
litter production, 447
nutrients, 286
organic matter, 286
phenological behaviour, 693
regeneration, 1346
species diversity, 144
succession, 136
understorey, 136

Value added products
processing, 4728

Vam fungi
acid phosphatase, 475
agroforestry, 487
azospirillum, 513
azotobacter inoculation, 504
biomass production, 504
rhizosphere, 487
rock phosphate, 475
soil properties, 509

Vanalakshmi

agroforestry, 2426
Vanuatu
provenance trials, 1821
Varanasi
litter decomposition, 463
Vascular anatomy
gender, 700
Vascular cambium
cell division, 712
dendrochronology, 736
seasonal behaviour, 734, 736, 4146
Vegetation
burning, 339
Himalaya, 52
India, 252, 359
Karnataka, 227
Madhya Pradesh, 54
rainfall, 252
regeneration, 52, 339
slash burning, 339
soil chemistry, 252
soil microorganisms, 481
soil properties, 227, 339, 359
South India, 1154
Tamil Nadu, 252, 359
Uttar Pradesh, 52
Vegetation communities
western ghats, 1164
Vegetation composition
species diversity, 143
Vegetation ecology
dry deciduous forests, 1153
wildlife management, 155
Vegetation map
Malaysia, 3261
Vegetation types
India, 322, 1093
Madhya Pradesh, 1112, 1165
soil chemistry, 296, 322
soil properties, 193, 199, 322, 357, 396
South East Asia, 396
succession, 1165
Tamil Nadu, 322
teak forests, 1112
West Bengal, 199
Vegetational analysis
degraded forests, 1369
Vegetative propagation
adventitious roots, 1676
air layering, 1724
branch cuttings, 1681, 1682, 1749, 1764, 1765, 1779
breeding, 749, 804, 1726
budding, 749, 1631, 1688, 1712, 1716, 1729, 1773, 1774, 1775, 1795
clonal forestry, 1674
clonal propagation, 1771
clonal seed orchard, 986
coppice, 1802
culm cuttings, 1740, 1751, 1756
culture technique, 1680
genetic improvement, 885, 951
grafting, 995, 1621, 1693, 1726, 1729, 1749, 1802
growth hormones, 1764
hormones, 1681
IBA, 1676
international cooperation, 928
microcuttings, 1751
mound layering, 1736
planting stock, 1716
plus trees, 958, 995, 1621
productivity, 1798
provenance trials, 928
root formation, 1717
root grafts, 1693
rooting, 1676, 1681, 1682, 1735, 1740, 1764, 1765, 1768, 1802
seed orchards, 958, 995, 1716, 1795
shoot cuttings, 1737, 1802
standardization, 1769
stem cuttings, 1717, 1768
storage technique, 1737
stumps, 1736
thiamine, 1676
tissue culture protocols, 1707
Veneer
adhesion techniques, 4714
fibreboard, 4705
floor tiles, 4669
grading rules, 4606, 4610
optical properties, 4671
panel, 4714
peeling characteristics, 4684, 4686
plywood, 4661, 4701, 4702
resin treatment, 4674
slicing characteristics, 4685
Veneer waste
pulping, 4729
Veneering industry
Madhya Pradesh, 4712
Venezuela
afforestation, 1862
alluvial soils, 592, 2324
basal area, 3580
bibliography, 3713
biomass, 264
Caparo forest reserve, 263
crown diameter, 3422
cultivation, 1926, 1928
fertilizers, 2324
genetic improvement, 791
growth modelling, 3422, 3580, 3581
height-diameter relationship, 3581
housing, 4540, 4624
intercropping, 1926
intermediate fellings, 2512
investments, 3712
logging, 2520
management, 3713
morphology, 1034
natural durability, 4530
nutrient contents, 592
particle boards, 4632
phosphorus, 2324
plantation establishment, 1928
plantation variation, 1034
plantations, 293
preservative treatment, 4540
properties, 4632
provenance trials, 791
silvicultural treatments, 2520
silviculture, 1223
site classification, 94
soil mapping, 293
soil nutrients, 263, 264
spacing, 2512, 3553
species trials, 1894
stand density, 1034
thinned wood, 4540
thinning, 2512, 3553, 3581
timber quality, 2585
volume equations, 3429, 3432
volume estimation, 3429
wood defects, 2585
yield, 293, 3553, 3580
Verbenaceae
species trials, 1894
Vertisol

soil properties, 227
Vesicular arbuscular mycorrhizae
Andhra Pradesh, 483
arbuscular mycorrhizae, 517
Assam, 514
azospirillum, 513
biofertilizers, 2268
clones, 518
Glomus caledonium, 2268
Glomus fasciculata, 483
Glomus mosseae, 483
infection, 476
Madhya Pradesh, 477, 517, 518
Maharashtra, 476
mycorrhizal colonisation, 518
mycorrhizal symbiosis, 484
nutrition, 483
plantations, 514
seasonal variation, 476
seedling growth, 486, 517
seedling vigour, 510
seedlings, 477, 510, 518
soil properties, 509
Tamil Nadu, 509
Thailand, 510
vam fungi, 491, 509, 510, 513
Vestured pits, 4122
Viability
pollen, 814, 828
Vidharbha
natural regeneration, 1264
Vietnam
afforestation, 76, 1819
comap model, 76
country reports, 43
greenhouse gas, 76
growth prediction, 3446
photosynthesis, 1819
physiology, 1819
plantations, 43, 1101
provenance trials, 968
seed collection, 1486
seed storage, 1486
working properties, 4427
Virgin islands
heartwood, 692
provenance trials, 1148
Vitality
wood properties, 4016
Vitex altissima
Hyblaea puera, 2998
Volume
Thailand, 3320
Volume age relationship
yield, 3283
Volume analysis, 3426
Volume determination
branches, 3538
Volume equations
Solomon Islands, 3445
Venezuela, 3429, 3432
volume estimation, 3429
Volume estimation
Costa Rica, 3323, 3459
felling, 3567
height diameter curves, 3374
Kerala, 3374
Venezuela, 3429
volume equations, 3429
yield, 3567
Volume increment
Eutectona machaeralis, 3018
Hyblaea puera, 3018
Volume tables, 3312
Bangladesh, 3329, 3366, 3367
coastal areas, 3540
crown diameter, 3520
Ghana, 3519
India, 3317, 3344
Indonesia, 3736
Latin America, 3551
Madhya Pradesh, 3319, 3742
Malaya, 3496, 3497
Malaysia, 3390
Myanmar, 3274, 3301, 3302, 3313, 3340, 3500, 3545
Nigeria, 3381
plantation grown teak, 3574
plantations, 2021, 3828
regression technique, 3367
rotation, 2021
Sri Lanka, 3828
Tanzania, 3280
Thailand, 3303, 3380, 3391
Volumetric index
stumps, 3462
Wagon building
carriage, 4616
Walayar
seed orchards, 1409
stump planting, 2218
Warts, 4122
Wastage
harvesting, 2534
Wasteland development
multipurpose trees, 2380
Water balance
radial growth, 661
Water blister
Kerala, 2166, 2579, 2580
Konni Teak Plantations, 2166
Water conditions
growth rings, 2308
Water conservation, 523
seedlings, 542
sloping land, 1907
soil properties, 297
stump planting, 1907
Water consumption, 532
Water cuttings
branch formation, 2216
Water extracts
germination, 609
Water loss
plantations, 544
Water relations
Dendrophthoe, 2656
Dendrophthoe falcata, 2655
Water soluble substances
dimensional changes, 4311
Water stress
photosynthesis, 540, 653
Water use
hydrology, 537
leaves, 647
photosynthesis, 646
Waterlogging, 536
Watershed management
hydrology, 541
water conservation, 523
Wearing qualities, 4546
Weathering
dimensional changes, 4297
fruits, 2711
Weathering resistance
strength properties, 4294
Weed control
arboricides, 2662
bamboo, 2658
chemical control, 2630
chemicals, 2664
Chromolaena odorata, 2670
Dendrophthoe falcata, 2644

fernoxone, 2653
growth, 2044
Imperata cylindrica, 2070, 2084
insect pests, 2634
Lantana, 2634
Lantana camara, 2651, 2911
Loranthus, 2628, 2640, 2643, 2657
Madhya Pradesh, 2434
Mikania cordata, 2669
Mikania micrantha, 2669
mistletoe, 2666, 2668
Nigeria, 2629
Octotoma scabripennis, 2911
Plagiohammus spinipennis, 2651
plantations, 2640
seed orchards, 2434
seedling morphology, 1647
Stylosanthes, 2434
Tanzania, 2044
underplanting, 2434
Uroplata girardi, 2911

Weed growth
plantations, 2636
slash burning, 218

Weedicides
mistletoe, 2646, 2648

Weeding
Angul, 2164
Burma, 1980
nursery practices, 2043
plantations, 1980, 2071
regeneration, 2164
Tanzania, 2203
Thailand, 2194

Weeds
biological control, 2665
Eupatorium odoratum, 2638, 2660
India, 2660
Indonesia, 2638
Kerala, 2660
mistletoe, 2652
Nectarinia asiatica, 2665
Nigeria, 2639
Panama, 1916
plantations, 2639
Saccharum spontaneum, 1916
thinning, 1990

Weight
biomass, 3384
specific gravity, 4218

West Africa
breeding, 919, 920
chemical composition, 256
dris evaluation, 88
fuelwood, 632
leaf analysis, 631
monoculture plantation, 406
nutrient cycling, 406
nutrient deficiency, 631, 632
provenance selection, 865
soil properties, 256
yield, 88

West Bengal
allelopathy, 601, 607
anthesis, 808
clay content, 364
cloning, 1701
Costus speciosus, 601
ecosystems, 2450
genetic variation, 744
growth stimulators, 607
increment, 364
infiltration capacity, 329
laterite soil, 371
lateritic belt, 368
leaf extract, 607
nutrients, 241, 303, 370, 371
plantations, 329, 1186, 2208
plus trees, 1701
pollen, 808
pollination, 808
rooting, 1735
seedling growth, 607
soil chemistry, 241, 303, 341, 368, 369, 370
soil compaction, 328, 329
soil properties, 199, 249, 251, 364, 368, 369
taungya, 2399, 2450
thatching, 4724
tissue culture, 1701
utilisation, 3999
vegetation types, 199
vegetative propagation, 1735
yield, 1186

West Indies
plantations, 1995
silviculture, 2156
wildlife habitat, 154

Western Ghats
field performance, 2260
foraging dynamics, 829
forest policy, 4765
litter decomposition, 428, 446
litterfall, 432
nutrient return, 432
plant invasions, 118
pollination, 829
seasonal variation, 446
silvicultural systems, 360
soil fungi, 446
soil properties, 360
vegetation communities, 1164

Wettability
wood properties, 4192, 4203

White grub
nurseries, 3114

Wildlife
ecology, 152
habitat use, 2679
plantations, 352

Wildlife conservation
Java, 2121

Wildlife damage
Baikiaea plurijuga, 1896
elephants, 2684
Parambikulam wildlife sanctuary, 2684
Zambia, 1896

Wildlife habitat
plantations, 153, 157, 2677
West Indies, 154

Wildlife management
vegetation ecology, 155

Wilting, 2706

Wind
protection, 2560

Windward islands
afforestation, 1861

Wood anatomy
bark, 4110
cambial activity, 673
cambium, 4106, 4135, 4136
crushing stress, 4132
defoliation, 4129
dendrochronology, 730, 731, 732, 736
dendroclimatology, 732
fibre length, 4128
fibres, 4114
growth rings, 673, 731, 4078, 4098, 4123
identification, 4095
identification key, 4100, 4105, 4115
interlocked fibre, 4117

juvenile wood, 673, 4129
mechanical properties, 4240
physical properties, 4077
plantation grown teak, 4137
plastid ultrastructure, 4106
root growth, 1183
sawdust, 4095
seasonal changes, 4146
seasonal variation, 724, 736
seed germination, 1183
specific gravity, 4131, 4132
stem analysis, 4138
vascular cambium, 736, 4146
vestured pits, 4122
warts, 4122
wood formation, 724
wood properties, 4240

Wood based industries
Myanmar, 3959

Wood borers, 2865

Wood carving, 4410

Wood chemistry
allergy, 4373, 4386
anthraquinones, 626, 4302, 4355
calcium, 210
caout chouc, 629, 4338
chemical composition, 4328
chromates, 4352
decay resistance, 629
dichloro diphenyl trichloroethane, 4556
dichromates, 4352
durability, 4362
eczema, 4386
extractives, 4338, 4351, 4355
extracts, 4354
gold, 4303
heartwood formation, 4113
silica, 4377
soil properties, 210
tectoquinone, 4325
utilisation, 4113

Wood colour
tectoquinone, 4237

Wood damage
fires, 2601

Wood decay
acoustic technique, 2744
strength retention, 4206

Wood defects, 2576
branch tearing, 2587
grain contraction, 4553
kiln drying, 4569
knotty teak, 2588
plantation grown teak, 4577
seasoning, 4553
timber loss, 3361
timber quality, 2585
trunk damage, 2587
wood quality, 4577

Wood density
carbon concentration, 4317
clones, 4197, 4198
environmental influence, 4242
growth rings, 4081
heartwood proportion, 4081
heritability, 4197
site factors, 4198
spacing, 4223
specific gravity, 4317

Wood destroying beetle
Thailand, 2810

Wood destroying fungi
Bengal, 2699
extractives, 4342
Irpex flavus, 2737
Malaysia, 2771, 2772
Pakistan, 2737
Polystictus steinhellanus, 2699

Wood destroying termites
natural resistance, 3068

Wood deterioration
weathering resistance, 4294

Wood durability
graveyard test, 4453

Wood dust
eczema, 583

Wood extractives
chemical properties, 4376
Germany, 4323
isolation, 4379
moulds, 4480
quinones, 4379
Reticulitermes, 2811
termites, 2811
wood preservatives, 4480

Wood finishing
furniture, 4400

Wood formation
growth periodicity, 3472
growth rings, 2308
seasonal variation, 724
water conditions, 2308

Wood poles
wood properties, 4271

Wood preservatives
pressure treatment, 4554
wood extractives, 4480

Wood properties
anatomy, 4014, 4097
bark, 4178
boats, 4292
branches, 4089
Brazil, 4049
Burma, 4035, 4235
caout chouc, 4360
chemical properties, 4042
China, 3996
chromatographic investigations, 4055
climatic factors, 4143
Cochin China, 3988
commercial timbers, 4065
construction, 4392
creamery churns, 4070
creeping behaviour, 4279
Cuba, 4097
cultivation, 1923
Dehra Dun, 3967
dielectric properties, 4152, 4194
dimensional stabilization, 4173
drying properties, 4187
durability, 4186, 4429, 4595
economics, 12
elasticity, 4204, 4276
electric moisture meter, 4170
extractives, 4341, 4383
fast grown timber, 4082, 4109
furniture, 4429
Germany, 4031
girdling, 2498
gluing, 4289
growth, 2631, 4143
growth rate, 4211, 4214, 4256
growth stress, 2581
hardness, 4308
heritability, 789
hysteresis properties, 4184
India, 12, 4020, 4045
Indonesia, 3992, 3993
insect pests, 12
iron, 4058
izod values, 4277, 4374
Java, 3985, 3987
joints, 4289, 4392

juvenile wood, 4085, 4093
Kerala, 4082, 4085, 4190
machining properties, 4036
Madagascar, 3964
Malaya, 4291
mechanical properties, 4240, 4288, 4290
mercury, 4178
mineral constituents, 4308
mistletoe, 2631, 2649, 2650, 4190
moisture content, 4059, 4203, 4230
Mozambique, 4014
Myanmar, 1923, 3985, 4005, 4238, 4239, 4267
nail holding properties, 4278, 4424
Nigeria, 3990, 4057, 4256
old wood, 4042
Papua and New Guinea, 4186
particle boards, 4665
permeability, 4043
Philippines, 4290
physical properties, 4288
plantation grown teak, 4019, 4057, 4060, 4096, 4238, 4239, 4256, 4267, 4287, 4290
plus trees, 4515
plywood, 4424
Puerto Rico, 4036
pulse transmission technique, 4276
rheological properties, 4341
rubber content, 4056
sanding, 4236
screws holding power, 4278
seasoning, 4036
seasoning defects, 4187
seed origin, 4049
shear deflection, 4169
ship deck, 4208, 4299
ships, 4292
shrinkage, 4231
Siam, 3985
silviculture, 7, 12
Solomon Islands, 4017
South East Asia, 4147
specific gravity, 4218
stress-strain behaviour, 4202
structural timber, 4636
swelling, 4231
tectoquinone, 4054
Thailand, 4001, 4033, 4050, 4065, 4066, 4287, 4288
timber quality, 4235
torsional properties, 4274
trade, 3966, 4005
Trinidad and Tobago, 4184
Uganda, 4029
ultra-violet light, 4055
utilisation, 4001, 4007, 4061, 4066, 4154, 4212, 4216, 4383, 4600, 4645, 4657
vitality, 4016, 4026
weight, 4218
wettability, 4192, 4203
wood anatomy, 4240
wood poles, 4271
wood quality, 4127
working stresses, 4406

Wood quality
fast grown timber, 4083
genetic variation, 860
grading, 4612
growth rate, 3481
heartwood proportion, 4120
Kerala, 860, 4083
Malaysia, 4612
Neotermes tectonae, 2925, 2926
plantation grown teak, 4577
sawnwood, 4612
seed origin, 1002, 1014
selection criterion, 860
specific gravity, 860
timber quality, 860
wood defects, 4577
wood properties, 4127

Wood structure, 4125
age, 728
bark, 4090
growth periodicity, 728
irrigation, 728
x-ray test, 4126

Wood thefts
Indonesia, 2565

Wood veneer waste
cement board, 4689

Wood wool board, 4672

Wood wool cement board
Indonesia, 4653

Workers
Indonesia, 2544

Working plan
Haliyal teak pole forests, 3827
Indonesia, 3614, 3615, 3626
Karnataka, 3827
Mae Ngao Forest, 3817
Maharashtra, 3847
Myanmar, 2551, 3865
Nilambur, 3815
Nilambur Forest Division, 3855
Nilambur Plantations, 3771
Thailand, 3817
Travancore, 3639

Working properties, 4199
Bulgaria, 4427
Colombia, 4162
India, 4414
painting, 4415
saws, 4416
suitability indices, 4419
Vietnam, 4427

Working stress
timber connectors, 4298
wood properties, 4406

World
country reports, 25
productivity, 11

World market
Java, 3944

Wyanad
growth, 3505
reproduction, 1295
resources, 4013
seeds, 1295
site factors, 4013
thinning, 1992, 1994, 2072
Udonga montana, 3036
yield tables, 3505

X-ray test
seeds, 1485
wood structure, 4126

Xyleborus
shot-holing, 3134

Xyleborus destruens, 2933
Indonesia, 2803, 2944, 3023
Java, 2945
Netherlands, 2933

Xyleborus morigerus
Mexico, 2812
parasites, 3153

Xyleborus similes, 2697

Xylem
caout chouc, 630
seasonal production, 4145

Xyleutes

Duomitus caramicus, 3067
Xyleutes ceramica, 2833, 2851, 2870, 2907, 2923, 2981, 3139, 3144, 3196
beehole borer, 2849, 2894, 2901, 3139
biological control, 2901, 3139, 3146
India, 2816
Indonesia, 3075
Malaysia, 2867, 2908
Myanmar, 2815, 2817, 2819
sex pheromone, 3021
stem borers, 2908
Thailand, 2901, 2907
Xylia dolabriformis
mixed planting, 2391, 2398
Xystrocera festiva
Indonesia, 3023
Yield, 3285, 3290, 3368, 3455, 3584
Africa, 1333, 3741
agroforestry, 2363
Andamans, 1186
Assam, 1186
Bangladesh, 3407
Benin, 88
Berkman's yield table, 3406
Bihar, 1186, 3683
Costa Rica, 3550, 3642
Cote d'ivoire, 88
Dahomey, 3641
dris evaluation, 88
economics, 2316, 3726, 3727
felling, 3567, 3584
financial analysis, 3726
grading, 3584
growth modelling, 3580
harvesting, 2542
Honavar range, 2058
increment, 3524
Indonesia, 2026, 2271, 2542, 3524
intercropping, 2271, 2363
investments, 3642, 3680, 3726, 3727, 3744, 3779
irrigated stands, 2316, 3435, 3436
Java, 3584
Karnataka, 3726, 3727
Kerala, 3744
Korai teak forest, 3647
Latin America, 3352
Liberia, 88
Maharashtra, 3680
Malaysia, 3290
management, 1972, 3697
mensuration, 3524
Myanmar, 3548
Nigeria, 88, 1116, 2179, 3283
Nilambur plantations, 3418
NPK fertilizers, 2271
Papua and New Guinea, 1149, 3393
plantations, 293, 1149, 1186, 1333, 2026, 3571, 3741
planting density, 3436
prices, 3680
private companies, 3680
productivity, 3418, 3552
rotation, 2054, 2055, 3727
selective logging, 2511
Senegal, 1333, 3741
site factors, 105
site index, 105
site quality, 88, 3550
soil fertility, 1333
soil mapping, 293
soil nutrients, 88
spacing, 2001, 2058, 2179, 2236, 3553
species introduction, 1116
stand density, 2236
stock estimation, 3511
sustained yield, 3744
teak forests, 2054, 2055, 2542, 3494, 3548
Thailand, 105, 848, 849, 2150, 2236, 2511, 3316, 3494, 3722
thinning, 2026, 3553
Togo, 88, 3779
United provinces, 1110
Uttar Pradesh, 1186
Venezuela, 293, 3553, 3580
volume age relationship, 3283
volume estimation, 3567
West Africa, 88
West Bengal, 1186
Yield prediction, 3351, 3489
density management diagram, 3470
Philippines, 3466
resource assessment, 3457
site quality, 3411
Taiwan, 3411
Yield regulation
brandis system, 3307, 3488
Myanmar, 3307, 3403, 3404, 3405, 3565, 3728
plantations, 3279
sustained yield, 3565
Yield tables, 3746
British India, 3521
Costa Rica, 3295
East Indies, 3521
France, 3333
Indonesia, 3286, 3314
Java, 3576
Latin America, 3551
Myanmar, 3410
Netherlands, 3521, 3563
Nigeria, 3281
Nilambur plantations, 3305
Nilambur, 3505
plantation grown teak, 3346
plantations, 1261, 3572
productivity, 3491
resource assessment, 3534
site index, 3281
site quality, 3491
stand tables, 3518
thinning, 2032, 3360
Trinidad, 1261, 3425
volume tables, 3551
Wyanad, 3505
Zaire
management, 2187
Zambia
species trials, 1842, 1896
Zeuzera coffeae, 2353, 2793, 2832, 2882, 2889, 2933, 2972, 2988
Zeuzera postexcita, 2832
Zeuzera roricyanea, 2972
Zimbabwe
seed processing, 1550
Zonocerus variegatus
leaves, 2799