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Contents

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Newsletter Committee (1994-1995)

Editor : E.M. Muralidharan
Associates : V.V. Sudheendrakumar
K.V. Bhat
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evergreen, the KFRI Newsletter is currently brought out in March and September each year and is intended for free private distribution within the Institute and the Kerala Forest Department. Free copies will also be sent upon request to other persons or institutions connected with forestry activities. The views expressed in the Newsletter are those of the authors and do not necessarily reflect views of the Institute. All interested persons are invited to send comments and opinions. The Newsletter Committee reserves the right to choose among contributions and edit wherever necessary.

Address all communications to : The Editor, Evergreen , Kerala Forest Research Institute, Peechi-680 653, Trichur, Kerala, India
ph:0487-782365, 782061 Fax:0487-782249

Dr. K.S.S. Nair takes over charge as Director

Following the retirement of Dr. S. Chand Basha on superannuation, Dr. K.S.S. Nair took over charge as Director of the Kerala Forest Research Institute in January 1995.

Dr. S. Chand Basha, IFS was deputed to KFRI from the Kerala Forest Department in May 1991 while he was serving as Chief Conservator of Forests, and he later rose to the position of Principal Chief Conservator of Forests. His stewardship in KFRI was marked by all round growth, which included addition of new buildings at the Peechi campus, establishment of a Field Research Centre at Palappilly, near Trichur and rapid progress in the construction of the Teak Museum at Nilambur. The period was also marked by substantial growth in the number of research projects taken up by KFRI. The staff of KFRI wish him continued success in his future endeavours.

Dr. K.S.S. Nair who succeeded Dr. S. Chand Basha has been heading the Division of Entomology of KFRI since the inception of the Institute and had contributed to the building up of the Institute in various ways. He obtained his Ph.D degree in Zoology in 1964 from the M.S. University of Baroda and from 1970 to 1975 worked as a Professional Associate in the Department of Environmental Biology, University of Guelph, Ontario, Canada, before joining the Institute. He has a wide background and experience in research, teaching, organisation of research activities and administration. He has over 100 publications including scientific papers, reviews, invited lectures, policy papers and edited books covering various aspects of forestry.

Dr. Nair was a member of the Contact Group established by the Centre for International Forestry Research (CIFOR) to develop specific agendas for strategic research in tropical forestry. He is presently the Chairman of the IUFRO (International Union of Forestry Research Organisations) Working Party on Protection of Forest in the tropics,

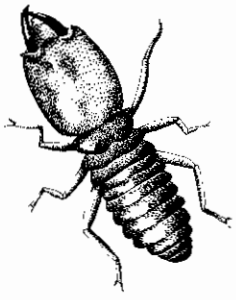
KFRI looks forward to greater excellence in research under his able leadership.

Termite control in eucalypt plantations

Among the forest plantation crops, eucalypts are the most vulnerable to attack by termites. Until recently the method of treatment standardized by KFRI (KFRI Information Bulletin No.3) has been successfully employed for protecting eucalypts from termites. This involved drenching the basketted seedlings prior to planting out with an appropriate dose of an organochlorine insecticide - aldrin or heptachlor. However, the ban on aldrin and heptachlor, due to environmental concerns necessitated the development of alternatives. Though heptachlor was initially included in the list of banned insecticides it is now exempted.

Heptachlor is an organochlorine insecticide which remains very effective against termites for a long period of time, when applied to the soil. In the method we recommended, it is used at the rate of 0.12 gram active ingredient per plant. Application is required only at the time of initial planting. Since replanting is done only after three rotations (30 years) including two coppice rotations, the rate of application or insecticide works out to 300 gm per hectare once in 30 years. This is too low (about 100 times lower compared to agricultural usage) to cause any environmental problems. We, therefore, recommend that heptachlor may be used when it is available.

In the meantime, we carried out a series of field trials at Kottappara using alternative, less persistent insecticides viz., the organophosphate , Chlorpyrifos and the synthetic pyrethroids, Cypermethrin and fenvalerate. The results obtained so far indicate that Chlorpyrifos is a suitable alternative although it may not be as effective as the cyclodiene insecticides. It can be used in the same manner as communicated earlier (For details see KFRI Information Bulletin No.3) except that a higher dose is required. Some of the trade names in which Chlorpyrifos is available in the market are Radar, Durmet, Piramid and Tafaban .



Brief details of method of application are given below:

When to treat: The treatment may be carried out any time after the seedlings have become established in the containers; the best period is between the second and fourth week after transplanting.

Preparation of the insecticide solution: To 125 litres of water in a drum, add 3 litres of Chlorpyrifos or 1.5 litres of Heptachlor (if available) and mix with a stick. Both the insecticides are available as 20 EC.

Method of application: The following precautions must be taken to ensure proper penetration of the diluted insecticide solution to the container soil.

1. Carry out the treatment on the evening of a sunny day, after skipping the regular watering in the morning. This is to render the container soil comparatively dry.
2. Ensure that the top edge of the container (polythene bag) projects above the soil level sufficiently to hold the insecticide solution.
3. If the bags are stacked too far apart, bring them closer to reduce wastage of the insecticide.

Drench each group of 2,500 seedlings with 125 litres of the insecticide solution with a rose can. The drenching may be carried out in two or three consecutive instalments, covering the entire group of 2,500 seedlings as uniformly as possible.

Is pit treatment necessary in addition to container treatment? No. If the container seedlings are treated as recommended above, no treatment of the planting pit is necessary.

Cost of insecticide: At the current price , if Heptachlor is used, the cost works out to about Rs.825 per hectare of plantation (2,500 seedlings) and if Chlorpyrifos is used it works out to Rs.975 per hectare. Labour cost is negligible as the treatment can be made as part of the regular watering operation.

Care in handling insecticides: All insecticides are poisonous. If the chemical spills over the skin, the area should be washed with soap and water. Persons with cuts or wounds should not be allowed to handle insecticides. Other safety precautions prescribed on the insecticide container should be followed.

For more information: Write to the Entomologist, K.F.R.I., Peechi-680 653, Thrissur, Kerala.

R.V. Varma and K.S.S. Nair
Division of Entomology

Significance of homegarden agroforestry in conservation of biodiversity and sustainable management of natural resources

There are two big problems for any developing country. The first is how to slow the rate of deforestation and forest degradation in the country. The second is how to satisfy the ever increasing demand for forest products,and especially the basic needs of the rural poor. In this context it is not difficult to appreciate the importance of agroforestry systems, that too the homestead farming which is the most prevalent type of agroforestry system in tropical regions. For example, in Kerala, homestead farming or homegarden agroforestry system is the major landuse system covering about 88% of the total land holding and about 41% of the total cultivable area of the State. Traditional homegardens are essentially mixed farming systems with an intensive integration of annual crops, perennial crops and animal husbandry practices often simultaneously, around the farmer's, dwelling place. These homegardens, characterised by forest-like multitier structure and possessing forest plant components,such as trees and medicinal plants, can reduce the pressure for harvesting in the remaining indigenous forests. Thus homegardens can provide a means of conserving indigenous forest cover and, in some instances, helping to maintain their biodiversity. Apart from this, there is the provision of products which people need; fuelwood, fodder, fruits and simple building materials for subsistence of rural communities, and pulpwood and lumber for the industry. Homegardens can also provide both social and economic benefits ranging from a diversification of rural employment to development of industrial processing. Though the primary function of the homegardens is the production of subsistence items, it can also be expected to render several other ecological and economic functions. Multi-tiered nature of the vegetation is expected to increase the utilization of the above-ground and below-ground environment and thus resulting in increased total biomass production potential. Plant diversity in homestead farming reduces the risk of complete crop failure, but can provide a wide range of plant products for human and livestock consumption.

... in Kerala, homestead farming or homegarden agroforestry system is the major landuse system covering about 88% of the total land holding and about 41% of the total cultivable area of the State.

So far, opportunities and benefits which agroforestry systems in general and homegarden systems in particular could provide are recognised. However, it is necessary also to focus attention on areas of concern so as to seek solutions to existing or potential problems. Though, some farmers are in favour of maintaining mixed farming systems which simulate natural forest lands and meet local needs and conserve regional biodiversity values, there is no total community commitment to do so. For example, now a days, the complexity of the homegardens is diminishing and the mixed farming systems are being changed into crop-dominant systems such as coconut-based, coconut-pineapple based, arecanut based, cocoa dominant, rubber dominant, pepper-coffee based systems and so on. Apart from socio-economic aspects and tendency of farmers to adopt monocropping systems over mixed cropping, lack of institutional back up and sound extension activities are also responsible for neglecting ecologically sustainable traditional mixed farming system. Thus, it is also reasonable to expect the government's positive actions such as launching of agroforestry extension activities, education and training for farmers on agroforestry, and supply of free seedlings, seeds and technical know-how, for attracting farmers to grow diverse varieties of plants. It may also be

..... homegardens, characterised by forest-like multi-tier structure and possessing forest plant components, such a trees and medicinal plants, can reduce the pressure for harvesting in the remaining indigenous forests.

Lack of solid research data to highlight the importance of trees -wild but useful plants of homestead farming,is another main constraint in revitalising traditional homegarden agroforestry practices.

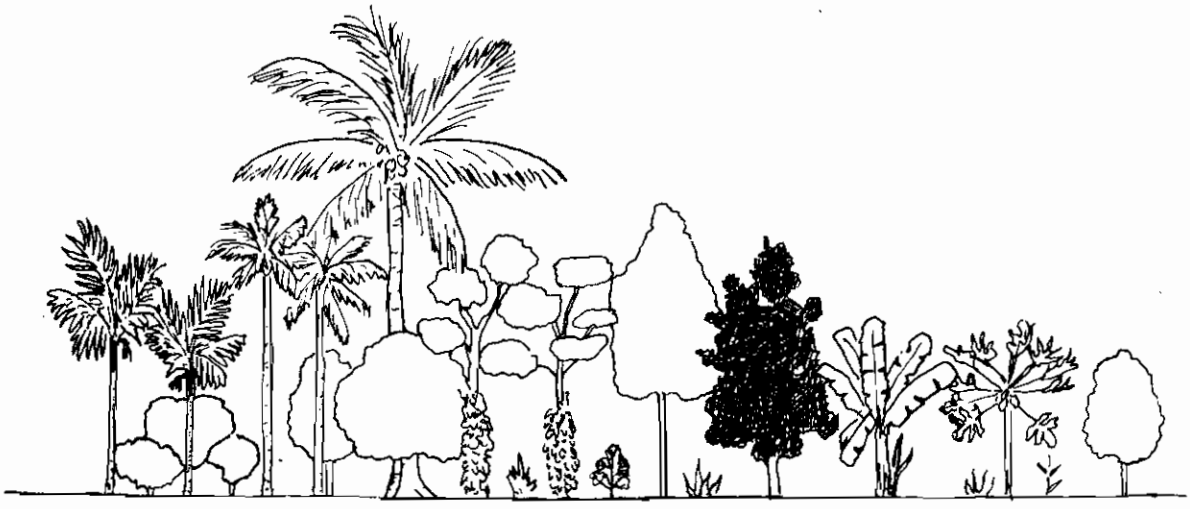
* *Based on a paper prepared for reading at the Diamond Jubilee Programme Activities of INSA and the satellite nation symposium of IUBS-INSA on "Biodiversity - Genes to Ecosystems:Towards Sustainable Management" held on 11-12 January, 1995 in New Delhi.*

pointed out that our primary and secondary and even higher institutions of learning do not have curricula on tree planting and agroforestry. Lack of solid research data to highlight the importance of trees - wild but useful plants of homestead farming, is another main constraint in revitalising traditional homegarden agroforestry practices. Autecological and synecological properties of trees and other plants, plant-plant and plant-soil interactions, economics of homestead farming, resource management and utilisation and other aspects are yet to be studied systematically. This is possible only when the funding agencies provide sufficient fund for conducting research on different plant components of agroforestry system at the same order of magnitude as that being given to control pests and diseases in cash crops and to breeding new varieties of rice.

..... effective conservation of biodiversity and sustainable management of natural resources will not be possible by the development of protected area network of natural ecosystems alone

Thus it can be concluded that the effective conservation of biodiversity and sustainable management of natural resources will not be possible by the development of protected area network of natural ecosystems alone. Any plan to conserve biodiversity and sustainable management of natural resources must include complementary management of man-made ecosystems such as species-rich homegarden systems. To achieve this, an effective research and extension programme as well as the involvement of local community in planning landuse improvement activities are also essential.

U.M.Chandrashekara
Division of Agroforestry



Developments in timber and timber products technology

Introduction

In India, with the increase in population coupled with the increase in the standard of living, demand for timber and timber products has shot up enormously over the years. In the past, the natural forests were exploited indiscriminately to meet the timber requirements resulting in large-scale depletion of our national forest wealth. With the alarming reduction in forest cover, timber supply from the natural forests dwindled rapidly. To safeguard the environment, felling of trees was banned in the country in the mid 1980s. Today, the natural forests are no longer the prime source of timber supply.

Short rotation plantations have emerged as a major source of timber.

Need for conserving the natural forests

With the need to conserve the natural forests for ecological reasons, we have to look for other sources of timber. Short rotation plantations have emerged as a major source. Even though plantation activities were initiated during the first Five Year Plan, it gained momentum in the 1980s. Maximum area of plantations is under *Eucalyptus tereticornis*. The most

preferred species under agro- forestry sector in northern India is *Populus deltoides*. One of the major alternative sources of timber supply in Kerala is rubber plantations (*Hevea brasiliensis*). Kerala, because of its equable, tropical climate, accounted for 384,000 ha area under rubber in 1990-91, nearly 90% of the total area under rubber in India. At the end of seventh Five Year Plan period, there were more than 17 million ha area under various plantations.

One thing we need to remember is that timber from short rotation plantations is quite different from that of natural forests. Presence of juvenile wood and growth stresses is higher. In some species, like rubber, reaction wood is a major problem. These result in wide variation in properties from pith to periphery leading to increased warping and cracking. Besides these, timber from short rotation plantations will have smaller girth. Timber for joinery or construction purpose from smaller girth logs will invariably have pith, which may result in boxed heart.

Wood substitutes

A global environmental awareness and the desire to conserve natural forests have led the Government of India to institute a scheme of labelling wood substitutes as Environment Friendly products vide Government of India Gazette Notification No. 71 dated February 21, 1991. According to the draft criteria brought out vide Government of India Gazette Notification No. 260 dated 11 June 1992, building boards from agricultural residues like bagasse, cotton stalk, rice husk and, wood residues (obtained in operations like felling, conversion and further processing) including lops and tops; and timber from sources other than natural forests have been qualified as wood substitutes which are environment friendly.

One of the major users of timber in India is the Central Public Works Department (CPWD) of the Government of India. In May 1992, CPWD decided to ban the use of solid timber in all its construction and housing projects from April 1993. This has since then been implemented. This has given impetus to using wood substitutes in the place of timber from natural forests.

Structural applications

Solid timber from natural forests should be substituted to the extent possible, with solid timber from sources other than natural forests. Materials like steel and aluminium, which are from non-renewable resources and which are high energy-intensive products, can only be poor substitutes for timber and they are not environment friendly.

..... rubber wood, when suitably treated and dried, is an excellent joinery, furniture and even construction material.

Solid timber is prized because of its high strength/weight ratio, easy workability, ability to be joined with a variety of fasteners, nails and screws, easy finishability and many other qualities. When properly processed (preservative treated and kiln-dried), some species can be made extremely useful. For example, rubber wood, when suitably treated and dried, is an excellent joinery, furniture and even construction material. With careful sawing and drying, even eucalypt wood can be made useful. Coconut palm is another source of solid timber. Coconut wood can be used for beams and rafters. India has about 1.1 million ha of area under coconut production. Even though wood composites can substitute timber from natural forests for many end use applications, when strength, stiffness, resistance to weather are primary consi-derations, timber from sources other than natural forests is far superior to many wood composites.

Next to solid timber from sources, other than natural forests, plywood, which is a layered composite, can be another material which can replace timber from natural forests. However, for long, plywood industry has depended on natural forests for its raw material requirement of large plylogs. In 1990, plywood production was 452,000 m^3. This is very much higher than all other composites put together. Importing plylogs can only be a short term approach. On a long term plan, plywood industry has to depend on raw material obtainable from plantations, especially fast growing small girth species. However, the industry is not fully prepared as the required technology for converting small girth plantation grown timber into plywood is not in existance now in the country.

Plywood retains characteristics of solid timber in terms of density, colour, texture and with enhanced properties like better dimensional stability, rigidity, fastner holding properties and more uniform strength properties in the plane of the board. High rigidity and stiffness, shear strength through thickness of plywood makes it a very efficient structural material in conjunction with solid timber.

One way to overcome the shortage of plylogs for the face veneers is to use bamboo mats. Reed bamboo with long internode has been found suitable for obtaining slivers for mat weaving. As bamboo has high tensile strength, panels made with bamboo mats have optimum strength properties.

Glued laminated timber (GLULAM) is another product which retains the

basic characteristics of solid timber with improved strength and stiffness. One major advantage is, glulam can be made from small section and short length timber. Even though techno-logy is readily available in India, it has not been introduced in the market. One reason is the cost of the cold-setting adhesive used in making glulam. However, it is a matter of time, before it is going to be accepted and used.

Compreg is another layered compo-site with wood veneers impregnated with phenol formaldehyde and greatly compressed. This is produced in India in limited quantities. It is a specialty product and finds application in high voltage electrical industries.

Technology for manufacturing wood polymer composite is available in the country but only a very insignificant quantity is produced. The applications are limited because of the cost which is prohibitive.

Non-structural applications

One way to substitute timber from natural forests is to utilize reconstituted panel products manufactured from wood residues, lops, tops, small girth and short length logs, and agricultural residues. These board products are highly suitable for non-structural applications like partitions, ceiling, cladding, etc.

Particle board was introduced into the country about 30 years ago. It has not gained adequate acceptance mainly because of its price which is higher than solid wood. The installed capacity of the existing particle board plants is about 76,000 tonnes per year; however, capacity utilization is only less than half. The service life of particle board in the tropical environment of the country has not been satisfactory. A more durable product would find greater acceptance. Weather resistant particle boards have been introduced in the country recently.

One of the major agricultural residues is rice husk. It is a byproduct of the rice milling industry. The present output is over 20 million tonnes per year. Weather resistant rice husk particle board is manufactured in India commercially. Rice husk is a durable material. The phenolic resin enhances the durability. As rice husk contains about 18 per cent silica, it makes the board resistant to termites and borers. Rice husk boards are currently manufactured in densities ranging from 500 kg / m^3 to 900 kg / m^3 and thickness 4 mm to 25 mm. Rice husk board, like wood-based particle boards, lacks structural strength. However, it can be made suitable for structural applications by reinforcing and / or overlaying with bamboo mat, wood veneer, jute fibre and mats, coir fibre, and metal wire and mesh.

One way to substitute timber from natural forests is to utilize reconstituted panel products .....

The cost of petroleum-based adhesive, phenol formaldehyde (PF), is what makes the particle board expensive. In spite of using PF adhesive, the particle boards have limited exterior applications. Cement-based wood particle board addresses the above two problems. Cement bonded particle board is a more compact panel having better weather resistance than general purpose resin bonded particle boards. One factory is manufacturing this panel product based on imported technology. Panels are made in the thickness range of 6 mm to 25 mm. Another panel product which uses inorganic binders like portland cement, gypsum and magnesium oxychloride is woodwool board.

Hardboard, a type of fibre board, has been manufactured in the country for many years on a limited scale. It has not made any appreciable impact as an alternative to solid wood. Medium density fibre board (MDF) has been introduced into the country very recently. Two factories are in commercial production. The disadvantages in solid wood like knots, splitting joints, bowed panels, bowed doors, loose-fitting drawers have been overcome in MDF. The physical and mechanical properties of MDF are more uniform than solid wood.

Technology for processing timber

The major operations involved in processing timber are drying and preservative treatment. Timber from most of the fast growing short rotation plantation species is non-durable. For most of the species both operations are required. Emphasis is being given to processes which are free from environmental pollution.

One drying system with great energy-saving potential and free from pollution is drying by dehumidification. This dryer differs from a conventional steam dryer in two ways. In the dehumidification dryer, moisture removed from the timber is extracted from the air flowing over the cold heat exchanger (the evaporator). In this way no energy is lost due to venting hot, moist air as is done in a steam dryer. And in the dehumidification kiln, the air heated by the hot heat exchanger (the condenser), or by the electric heating coil during the initial drying period, rather than by a steam boiler.

The air in the dehumidification dryer is moved through the wood stack by a fan as in a conventional kiln. However, part of the moist air leaving the stack is circulated through the dehumidifier to remove part of the water vapour and to heat the air.

The advantages of dehumidification drying compared to conventional kiln-drying are lower drying degrade and ease of operation. The disadvantages are slower drying and greater energy consumption in drying timber to below 15% moisture content. Equalizing and conditioning are difficult because steam is usually not available.

Dehumidification drying kilns are available in India. This type of driers are ideal for drying small volumes of very valuable timbers that have to be dried very carefully, for example, rosewood for handicraft.

A drying system, which reduces the drying time considerably and at the same time minimizes drying defects, has been introduced in the country recently. Unlike a conventional kiln, here the drying is carried out in a pressure cylinder. Initially, a vacuum is created in the pressure vessel and the pressure vessel is then filled with super-heated steam at a temperature of 60-90° C. With a relative vapour pressure lower than 100 per cent, the super-heated steam will absorb water from the timber when circulated in the pressure vessel. The drying is controlled by regulating the relative vapour pressure of the super-heated steam.

Some timbers are difficult to treat with preservative chemicals even under pressure. For example, eucalypt timber belongs to durability class III and treatability class e. For such timbers, oscillating pressure method (OPM) is highly suitable. In this method, instead of one vacuum-pressure cycle normally employed, there will be a number of vacuum-pressure cycles with decreasing period of vacuum and increasing period of pressure. One modification to this method is alternating pressure method (APM). Here, the equipment is less complicated than in OPM. After pressure period, it is brought down to atmospheric pressure instead of vacuum.

Assessment

Many technologies for processing timber and manufacturing timber and timber products have been introduced in the country recently. Some are indigenous technologies developed in research institutions and in private sector and many are imported technologies. Environmental concerns have become the major factor in deciding the product and technology. We have to utilize the available timber resources judiciously in such a way that the natural forests are conserved and managed in sustainable manner. For this we need to develop and introduce better and efficient technologies for fuller utilization of the raw material.

R. Gnanaharan
Division of Wood Science

Weather data for Peechi (1994)

There was more rainfall at Peechi as compared to the previous year. The south west monsoon hit Peechi by May 26 and withdrew on September 9th contributing about 2534 mm of rainfall. The north east monsoon followed in October and withdrew by 6th November contributing about 375 mm of rainfall. The total rainfall including the summer showers amounted to 3169 mm. The number of rainy days, when rainfall was greater than 10 mm, was 91 days which is 18 days more than that of the previous year. The monthly rainfall for the year 1994 is presented graphically in Fig.1.

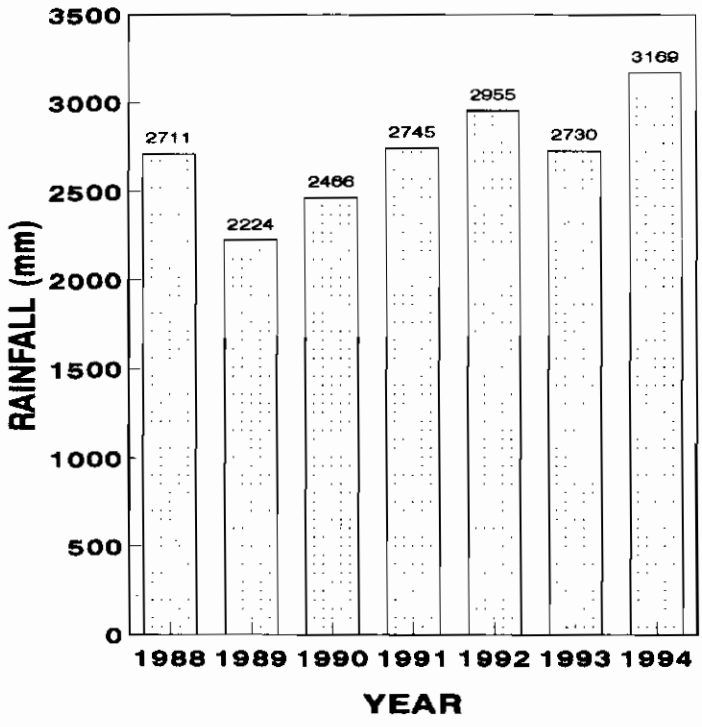
The maximum temperature recorded during the year was in March (40°C) while the minimum temperature was in January (17°C). Relative humidity varied between 27% and 97% during the year. From January to March average bright sunshine was high in January showing an avergae of 8.7 hrs. In July sunshine was limited to an average of 1 hr a day.

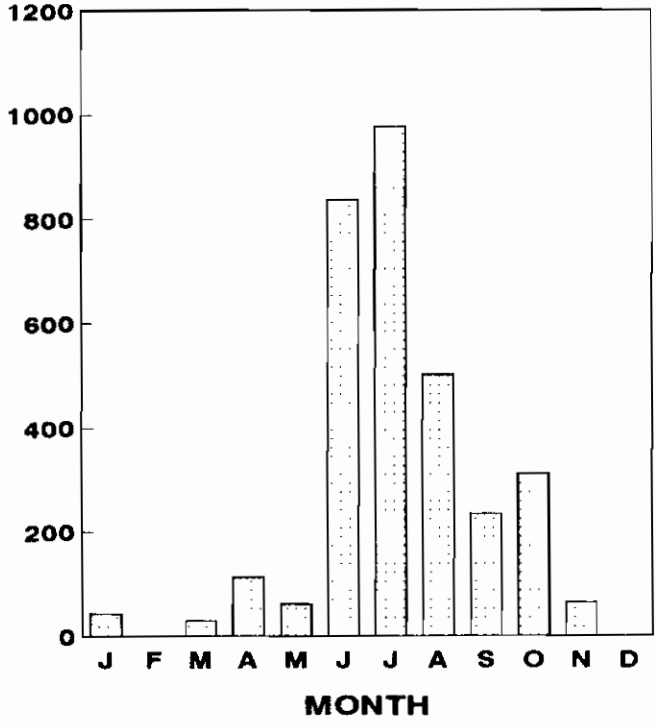
Details of specific dates, monthly averages of weather parameters, cumulative rainfall etc. recorded at KFRI weather station are given below.

Jose Kallarackal and C.K. Somen
Plant Physiology Division

Highlights

Day with highest maximum temperature	: 10 to 14th March (40°C)
Day with least minimum temperature	: 29th January (17°C)
Day with highest maximum r.h.	: 1st, 29th Oct and 5th Nov (97%)
Day with least minimum r.h.	: 9th March (27%)
Total rainfall for the year	: 3169 mm
Day with maximum rainfall	: 12th July (132 mm)
Month with maximum rainy days	: July (25 days)
Total number of rainy days	: 91 days
Day with maximum sunshine	: 1st and 3rd May (10.5 hrs)
Month with maximum sunshine	: January (8.7 hours)





(a). Cumulated annual rainfall from 1988 to 1994 at Peechi. (b). Cumulated monthly rainfall for 1994 at Peechi.

Table.1. Monthly averages of weather data for 1994 at Peechi
(Latitude 10°32'N Longitude: 76°20'E Altitude 100 m)

Month	Mean Temp (°C)		Mean r.h.(%)		Rainfall (mm)		Daily mean Wind velocity (km/hr)	Daily mean Bright Sunshine (h)
	Max	Min	Max	Min				
January	34.40	20.70	79.00	45.00	43.00	(1)	2.50	8.70
February	36.90	21.60	85.00	44.00	0.00	(0)	1.90	8.20
March	38.50	22.60	83.00	38.00	29.00	(1)	1.80	8.70
April	36.80	23.30	76.00	45.00	112.00	(5)	1.30	7.00
May	36.10	23.60	75.00	48.00	60.80	(1)	1.30	4.90
June	30.00	21.70	89.00	74.00	837.00	(21)	1.50	1.50
July	29.50	21.10	92.00	77.00	976.80	(25)	1.30	1.00
August	30.20	21.30	94.00	74.00	501.40	(16)	1.00	2.20
September	32.50	21.90	93.00	66.00	234.00	(6)	1.20	3.60
October	33.50	21.70	94.00	64.00	311.00	(12)	0.90	4.90
November	33.00	22.00	91.00	62.00	63.60	(3)	2.20	6.70
December	33.00	20.60	79.00	49.00	0.00	(0)	2.30	7.80

Note: r.h.: Relative humidity; The figures in parenthesis indicate the number of rainy days when rainfall was >=10 mm.

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Research Reports

Use pattern and chemical characterisation of the natural salt licks in Chinnar Wildlife Sanctuary. KFRI Research Report No. 94. Final Report of Project No. KFRI/ 132/90. Ramachandran, K.K., M. Balagopalan, P. Vijayakumaran Nair. 1994.

Abstract: A study was conducted during 1990-92 in the Chinnar Wildlife Sanctuary (10° 15' to 10° 22' N latitude 77°05' to 77°17' E longitude) of Kerala State to characterise the natural salt lick sites and gather information on their usage by wild animals. Four sites were selected three in natural salt lick areas and one outside the salt lick which remained as control. For comparison purposes, two sites viz. Anakkatty and Munnar were also selected. From each site, ten soil surface samples (0-20 cm.) were taken at random. The soils were characterised and the total sodium, potassium, calcium and magnesium contents were estimated. The animal visits were recorded through regular field observations and the degree of their use, by monitoring the laid out impression pad. The soils in the natural salt lick sites had higher sodium, potassium, calcium and magnesium contents as compared to control and comparison sites. Sodium content was dominant in the natural salt lick sites. Herbivores like elephant, spotted deer (*Axis axis*) and sambar deer (*Cervus unicolor*) use the salt licks. There was very little evidence of gaur (*Bos gaurus*) using the salt licks. Animals use the salt licks irrespective of the season and age.

Development of a management strategy for the teak defoliator, *Hyblaea puera*. KFRI Research Report No.95 pp. 156. Final Report of Project No. KFRI/101/87. Nair, K.S.S., Mohanadas, K. and Sudheendrakumar, V.V. 1994.

Abstract: The population dynamics of *Hyblaea puera* was investigated over a 3 year period by sampling immature stages of the pest, at weekly intervals, from 3 permanent plots and a number of 'moving plots' within a 1000 ha. teak plantation.

Data on insect counts showed that between-shoots variation accounted for 32% of the total variance, between-trees variation of 26%, and interaction between crown-levels and trees for another 26%. Between-plots variation was only 10%, but it differed very substantially between sampling, dates, accounting for upto 58% on some dates, indicating that the infestation was not uniform over the entire area on some dates.

Generally, eggs are laid only on tender leaves and the neonate larvae do not survive on older leaves. Based on infestation characteristics, two kinds of populations are recognized - low density populations and high density populations. Low-density populations, with less than 2 insects/ shoot, had a mixed age-structure, while high-density populations with upto 14 insects/shoot were characterised, by predominance of one developmental stage at any given time. For both kinds of populations, the immature stages follow a negative binomial distribution on shoots, similar to that of many other insects. The sample size required to estimate the population at not more than 10% error worked out to 94 shoots for high-density populations and 566 shoots for low-density populations, or at the rate of shoots per tree, 16 trees for the former and 94 trees for the latter.

Several distinct phases were recognised in the annual population trend: the first phase, often starting from the 4th week of February, is characterised by small-patch infestations which appear erratically in some areas, followed by the main infestation season after which the population density declines and infestations again become erratic. Following a full period, erratic infestations appear again in August, September or October and then subside. Until the cycle begins again next year, the population remains almost undetectable.

Because of the shifting foci of infestations due to the mobile nature of moth aggregations, parasitoids were not capable of regulating host numbers during outbreaks. A large number of predators were active during outbreaks, but they did not have much impact on the host population because of the sheer host population size. Disease caused by a specific NPV, was prevalent during the later generation and caused heavy mortality of larvae and pupae after the main outbreak phase, often leading to complete collapse of local population.

There was a time-lag between flushing of teak trees and occurrence

of large-scale defoliator outbreaks, indicating the operation of a positive feed-back of tender foliage on build-up of moth populations necessary for outbreak development.

The time of occurrence of the first phase of outbreaks was strongly correlated with the appearance of pre-monsoon showers. Indirect evidence suggests that the weather system causing the rainfall somehow aids aggregation and displacement of moth populations, pointing to the need for further investigations.

It is shown that *H. puera* population outbreak is of the eruptive type, according to Berryman's classification scheme.

Physical and anatomical characteristics of wood of some less-known tree species of Kerala. KFRI Research Report No. 96. Final report of Project No. KFRI/113/87. Bhat, K.V. 1994.

Abstract: Wood characteristics of 21 lesser-known tree species of Kerala forests were examined in the present study. The properties investigated include physical features of wood like colour, grain, texture, heartwood content, basic density and shrinkage in addition to the anatomical structure of the wood. Majority of the timbers examined have density value comparable to commonly used structural and joinery timbers. However, only a few species like *Aglaia barberi, Aporusa lindleyana, Ormosia travancorica and Pterospermum rubiginosum* possess a distinct, wide heartwood. Rest of the species which have a narrow or indistinct heartwood are not likely to be durable unless treated with preservative chemicals. Except for a few species like *Euodia lunu-ankenda, Aporusa lindleyana, Ormosia travancorica* and *Syzygium chavaran* the majority of timbers have high shrinkage. A number of species are likely to be useful for furniture making or turnery due to their decorative figure and fine texture. However, a few like *Garcinia morella, Madhuca bourdillonii, Mastixia arborea* and *Polyalthea coffeoides* were found to be less suitable for the above purposes. On the whole, the study suggests that a good proportion of the native, less-known hardwoods possess timber value which can be exploited for achieving optimum use of the resource.

Decay of standing trees in natural forests. KFRI Research Report No. 97. Final report of Project No. KFRI/106/87. Mohanan, C. 1994.

Abstract: Ocular appraisal on occurrence of decay in living trees in natural stands in the State employing external decay indicators revealed an average incidence of 20.7%. Highest percent incidence of decay of 23.6 was recorded in the evergreen forest at Aramba (Achenkoil Forest Divn.) and lowest in the semi-evergreen forest at Kottiyoor (Kannur Forest Divn.), while in wet-evergreen forest at Panthanthodu (Silent valley National Park), it was 18.71 %. Among the seven categories of decay indicators viz., swollen knot, swollen bole, punk knot, canker and open wound, hollow in the bole, sporophore, branch stub and rotten branches, all the indicators except punk knot occurred in comparatively high frequency. Altogether 44 polypores belonging to 18 genera were found associated with decay in living trees. Nine polypores caused brown-rot, while all the rest were associated with white-rot.

Detection and estimation of decay in standing trees in natural stands at Aramba (SFC III) were made by non-destructive as well as destructive methods. Ocular appraisal of 139 trees belonging to 12 species revealed that 66% of the trees contained decay. Direct probing of the wood with the shigometer proved less reliable in detecting the decay in living trees.

In ocular appraisal, a total of 794 external decay indicators belonging to seven categories were recorded on 139 trees and in destructive sampling 495 indicators belonging to all the seven categories were found associated with decay, entailing a total loss of 129.63 m^3 of timber. Swollen bole and sporophore were associated with decay in all cases. Hollow in the bole, canker, open wound and swollen knot were the other indicators which showed high percentage of association with decay. Though, branch stub and rotten branches exhibited high frequency of occurrence (376), they showed least association (26.33%) with heartrot in trees. For detecting and estimating the heartrot in trees, swollen bole and sporophore were found to be the most reliable indicators, followed by hollow in the bole, and canker and open wound. Among the twelve tree species studied, *Vateria indica* exhibited highest number of external decay indicators (264) belonging to all the seven categories and an average of 3.42 m^3 decay volume per decayed tree.

Regression analysis revealed sporophore, canker and open wound, tree dbh, hollow in the bole and swollen bole as the most reliable variables in predicting the decay volume in mixed stand, whereas hollow in the bole, tree dbh and swollen bole were the reliable variables in natural stands of *V. indica*. Decay prediction equations were generated separately for *V. indica* and mixed natural stands

Diseases of bamboos and rattan in Kerala. KFRI Research Report No. 98. Final Report of Project No. KFRI/110/87. Mohanan, C. 1994.

Abstract: Survey revealed a total of 64 pathogenic diseases including one of unknown etiology, possibly a virus, affecting different species of bamboo and rattans in nurseries, plantations and natural stands. Altogether 56 pathogens were associated with these diseases, of which 31 are new pathogen records for bamboo and 16 for rattans, including 13 hitherto undescribed species; 24 species are first record from India.

In bamboos, thirteen seedling diseases affect both bareroot as well as container seedlings at different growth phases. With these diseases, altogether 14 fungi belonging to 11 genera were found associated. One disease, seedling foliage striping and stunting was of unknown etiology and possibly it was caused by a virus. Of the 14 fungi found associated with various diseases in bamboo nurseries, *Rhizoctonia solani* emerged as the most dominant nursery pathogen, causing four diseases viz. damping-off, seedling spear rot, seedling wilt and web blight.

Among the foliage diseases affecting nursery seedlings, leaf rust caused by *Dasturella divina* was widespread in occurrence as it was recorded on seedlings of almost all the bamboo species raised in nurseries in the State. *Bipolaris maydis, B. urochloae* and *Bipolaris* sp. caused leaf blight; *Exserohilum holmii* and *E. rostratum* caused leaf spots on various species of bamboos. Seedling rhizome rot of *B. bambos* caused by *Rhizostilbella hibisci* state of *Nectria mauritiicola* was recorded in container seedlings. Leaf striping and stunting disease, the symptoms of which were found characteristic of those produced by a virus, occurred in *B. bambos* seedlings.

In bamboo plantations and natural stands, a total of 28 pathogenic diseases caused by 35 fungi and one mycoplasma-like organism (MLO) were recorded. Of these, only rhizome bud rot caused by *Pythium middletonii* occurred exclusively in young plantations, while witches' broom caused by *Balansia linearis* and little leaf disease caused by MLO were recorded only in natural stands. Rest of the diseases were found both in plantations as well as natural stands.

Rot of emerging culms caused by *Fusarium moniliforme* var. *intermedium* and rot of growing culms caused by *F. equiseti* occurred both in plantations and natural stands and was widespread in the State. Both the diseases affected the culm production in plantations and natural stands. Die-back of branches caused by *Fusarium pallidoroseum*, thread blight caused by *Botryobasidium salmonicolor* affecting foliage, culms and branches, foliage blight caused by *Bipolaris maydis* and *Bipolaris* sp. and *Dasturella divina*, causing leaf rust, were recorded in bamboo plantations as well as natural stands. Seventeen foliar diseases of minor significance with which twenty two species of fungi belonging to 17 genera were also recorded on different species of bamboos in plantations and natural stands. Basal culm decay and withering caused by *Ganoderma lucidum* and *Amylosporus campbelli*, and culm staining and die-back caused by *Apiospra* sp. occurred in old clumps in natural stands and plantations.

In rattans, altogether 11 seedling diseases were recorded both in bareroot as well as container nurseries with which 13 fungi were associated. Seedling collar rot caused by *R. solani, S. rolfsii, F. longipes* and seedling blight caused by *Guignardia calami* were the economically important nursery diseases. Among the seven leaf spot diseases caused by *C. gloeosporioides, B. ellisii, Corynespora cassicola, A. alternata, P. theae, C. lunata* and *Phomopsis* sp., leaf infection caused by *C. gloeosporioides* was widespread and occurred in most of the rattan species.

In rattan plantations and natural stands, altogether 12 diseases were recorded. Of these eight foliage diseases were caused by 11 fungi of which six were also associated with the seedling diseases in rattan nurseries. Among the foliage diseases, leaf blight caused by a hitherto undescribed *Sphaerodothis* sp. was the most widespread in occurrence. *Corynespora* sp., and *Phomopsis* sp. were the other two hitherto undescribed species which caused leaf infection. In rattan plantations, fruit rot caused by *F. moniliforme* has a potential to become a serious disease.

New Research Projects

KFRI/230/94: **Biodiversity in Tropical Moist Forests: A Study of sustainable use of Non-Wood Forest Products in the Western Ghats. Kerala.**

Investigators: P.K. Muraleedharan (Economics), N. Sasidharan (Botany), K.K. Seethalakshmi (Physiology), E.M. Muralidharan (Genetics).
Objectives: i. To identify the NWFP's and record their uses with the help of tribal communities and other interest groups. ii. to study sustainable extraction methods of NWFPs and to conserve endangered species. iii. To examine Socio-economic aspects of collection, marketing and utilization of NWFPs. iv. To prepare a participatory management action plan for maintaining bio-diversity and sustainable use of NWFPs and to examine its possible impacts on various interest groups.
Duration : 3 Years
Funded by: The Ford Foundation.

KFRI/231/94: **Preparation of maps of Kerala showing protected areas and forests**

Investigator: A.R.R. Menon (Ecology)
Objectives: To prepare maps of Kerala showing the protected areas and forests
Duration : 6 months
Funded by : Kerala Forest Department.

KFRI/232/94: **Rhizome and root morphology of rattans**

Investigators: C.Renuka (Botany), K.K. Unni (Botany)
Objectives: i. To study the development of the root system and the rhizomes of rattans ii. To compare the development of root systems and rhizomes of different species.
Duration: 3 years
Funded by: KFRI

KFRI/233/94: **Post harvesting manuring in *Bambusa bambos* plantation.**

Investigator: T.P. Thomas (Soil Science)
Objectives: To study the effect of different growth promoters on the growth of *Bambusa bambos* plantations after harvesting of mature culms.
Duration: 1 year
Funded by: KFRI

KFRI/234/94: **Preperation of exhaustive flora of Kerala Forest Research Institute campuses at Peechi, Velupadam and Nilambur.**

Investigators: K.K.N.Nair(Botany), K. Yesodharan (Botany), Santosh John (KFRI Sub-Centre, Nilambur), K.K. Unni (KFRI Field Station, Velupadam).
Objectives: i. To explore the flora of the KFRI campuses at Peechi, Velupadam and Nilambur.ii. To prepare herbarium specimens/ preserved materials and compile the flora of the campuses.iii. To label, especially trees in the three campuses.
Duration: 1 year
Funded by : KFRI

KFRI/235/94: **Harvesting trials on bamboos**

Investigator: R.C.Pandalai (Silviculture)
Objectives : i. To study the effect of different culm cutting patterns and pruning on culm production and rhizome growth in bamboos. ii. To recommend a harvesting practice for bamboo clumps.
Duration : 3 years
Funded by: KFRI

KFRI/236/94: **Generation and transfer of silviculture and harvesting technology of selected medicinal plants for sustained utilization of the wastelands of Kerala.**

Investigators: K.K.N. Nair (Botany), R.C. Pandalai (Silviculture), U.M. Chandrasekhara (Agroforestry), E.M. Muralidharan (Genetics)
Objectives: i. To generate botanical and distribution data on species selected for the study.ii. to evolve propagation and silvicultural techniques for the species and to raise seedlings for planting in institutional and private land. iii. to transfer the technology to selected farmers. iv. to gather information on associated species, planting designs, crop relationss and socio-economic conditions of farmers.
Duration : 4 years
Funded by: Dept. of Wasteland Development, Ministry of Rural Development.

KFRI/237/95: **Conservation, management and sustainable utilization of non-timber forest products in Southern Western Ghats, Kerala, India**

Investigator: S.Sankar (Agroforestry)
Objectives: To develop a natural resources and environment accounting system for the area so as to assist in planning and implementing a sustainable forest based enterprise involving local people.
Duration : 1 year
Funded by: Biodiversity Support Programme - WWF

KFRI/238/95: **Fungal pathogens as a potential threat to tropical acacias - a case study of India.**

Investigators: J.K. Sharma, E.J. Maria Florence (Pathology)
Objectives : i. To conduct a disease survey of the exotic tropical acacias: *Acacia auriculiformis, A. mangium, A. crassicarpa* and *A. aulocarpa* in trials and commercial plantings in India to provide an indication of the potential of fungal pathogens as a limiting factor to growth and productivity.
Duration : 1 year
Funded by: Centre for International Forestry Research (CIFOR), Indonesia.

Errata:

In the last issue of Evergreen (No. 32-33, March-September 1995) some details about the Project No. KFRI/217/95 were inadvertently omitted. The entry should be as follows:

KFRI/217/94 : **Studies on the effect of fire on forest soils, vegetation and timber value.**

Investigators: K. Swarupanandan (Ecology), C.N. Krishnankutty (Statistics), T.P. Thomas (Soil science), K.V. Bhat (Wood Science), T.Surendran (Physiology), K.V. Sankaran (Pathology).

Objectives: i. To study the changes brought about by fire on soil physical and chemical properties. ii. To examine the qualitative and quantitative changes in soil microflora due to fire and to assess how fast the original status is regained. iii.To identify fire tolerant and fire hardy tree species and to test the feasibility of stump planting. iv.To assess the survival ability of regenerants (of 1-3 cm dbh). v. To assess the type and extent of damage to tree species.vi.To study the response of fire exclusion in forest vegetation.
Duration : 4 Years
Funded By: Kerala Forest Department

Participation in Seminars, Symposia and Workshops

Dr. Balagopalan participated in the 7 th Kerala Science Congress held at Palakkad during January 27-29, 1995 and presented a paper entitled *'Changes in the distribution of organic carbon and different forms of nitrogen in soils under natural forest and teak plantations'*.

Dr. K.M. Bhat attended a Workshop on *Albizia* and *Paraserianthes* held in Mindanao, Philippines during November 13-18, 1994 and presented a paper on *'Wood properties and utilization of Indian* ***Albizia*** *spp.: An assessment in the context of species selection for planting'*. Dr. Bhat also chaired a technical session as a Working Group Leader of Timber Management.

Dr. K.M. Bhat participated in the Post-harvest Technology Working Group (INBAR) Meeting held in Quzen City, Philippines during November 23-25, 1994 and presented a paper on *'Industrial utilization of bamboo and rattan: An overview'*. He also visited the Ministry of Forestry (Standardisation of Forest Products & Quality Control), Jakarta, Indonesia during November 26-28, 1994 in connection with INBAR internship on 'Standardisation of rattan grading rules'.

Mr. K.C. Chacko attended an Expert Consultation Meeting on Non-Wood Forest Products, organized by the FAO and the Government of Indonesia at Yogyakarta, Indonesia during January 17-27, 1995.

Dr. U.M. Chandrashekara attended the Diamond Jubilee Programme of INSA and the Satellite nation symposium of IUBS-INSA on **'Biodiversity- Genes to Ecosystem: Towards Sustainable management'** held during January 11-12, 1995 in New Delhi. He presented a paper entitled *'Significance of homegarden agroforestry in conservation of biodiversity and sustainable management of natural resources'*.

Dr. George Mathew attended the second National Conference of AZRA held at Madras Christian College from December 27-29, 1994. He chaired the session on *'Plant products in pest control'*.

Dr. George Mathew attended the National Conference on 'Biological and cultural control of agricultural and medical pests' at St. Xavier's College, Palayankotta from February 22-24, 1995 and gave an invited talk *'Biosystematics of insects and its application in biocontrol programmes'*.

Dr. R.Gnanaharan and Dr.K.M.Bhat participated in the Interdisciplinary Plant Biomechanics Congress held in Montpelliar, France during September 5-9, 1994 and presented

the following papers respectively: *'Biomechanical response of reed bamboo along the length of the culm and across the culm wall thickness; Structural basis for biomechanical behaviour of rattan.'*

Dr. R. Gnanaharan attended a Workshop on the Environmental Implications of Cost-Effective Technology held at Thiruvananathapuram on October 4, 1995 and presented a paper, *'Timber substitutes and their environmental implications'*.

Dr. R. Gnanaharan attended the Rubber Wood Task Force Meetings held at Kottayam on September 1 and October 11, 1994. He prepared a Draft Standard on Processed Rubber Wood and submitted to the Bureau of Indian Standards.

Dr. R. Gnanaharan attended the Bureau of Indian Standards Subcommittee CED 20:1 meeting held at Bangalore on November 14, 1994.

Dr. K. Jayaraman, Mrs. P. Rugmini and Mr. C.N. Krishnankutty attended the 48th Annual Conference of the ISAS held at College of Veterinary and Animal Sciences, Mannuthy during December 15-17, 1994. Dr. Jayaraman delivered a talk on *'Data analysis in forestry sector'*.

Dr. Jose Kallarackal attended the Annual General Meeting of the Australian Society of Plant Physiologists held in Gold Coast, Australia from September 28-30, 1994 and presented a paper *Water use of **Eucalyptus tereticornis** at two sites with different stand density in the tropics* by J. Kallarackal and C.K. Somen.

Dr. Jose Kallarackal attended the Annual Project Review Workshop of the Ministry of Environment and Forests held at the University of Goa, Goa from January 30 to February 1, 1995 and presented the details of the project on eucalypts.

Dr. P.K. Muraleedharan attended an Expert Consultation Meeting on Non-Wood Forest Products, Organised by FAO and Government of Indonesia, at Yogokarta, Indonesia during January 17-27, 1995.

Dr. E.M. Muralidharan attended the 7 th Kerala Science Congress held at Palakkad from January 26 - 29, 1995 and presented a paper entitled *'An evaluation of cost-reduction measures in micropropagation'*.

Dr. R.C. Pandalai gave a lecture on *'Nursery practices'* for NGO's and voluntary agencies on December 21, 1994 at Peechi.

Dr. K.V. Sankaran participated in the V International Mycological Congress held at University of British Columbia, Vancouver, Canada during August 14-21, 1994 and presented a poster entitled *'Status of mycorrhizal associations in **Acacia auriculiformis** plantations in Kerala.*

Dr. N. Sasidharan gave the Keynote Address at the function held on February 4, 1995, at Periya to launch the Medicinal plants cultivation scheme sponsored by FRLHT, Bangalore.

Dr. N. Sasidharan attended the CAMP (Conservation Assessment Management Plan) Workshop on threatened medicinal plants of South India, during February 23- 25, 1995 at Bangalore.

Dr. N. Sasidharan attended the Seminar on 'Local Knowledge on Health Care' and presented a paper 'Local health traditions of India' on February 26, 1995 at Engandiyur, Trichur.

Dr. V.V. Sudheendrakumar participated in the International Symposium on Asian Tropical Forest Management held at Centre for Reforestation Studies in the Tropical Rain Forests, Samarinda, Indonesia from September 13-15, 1994 and presented a paper on *'Insect pest problems of forest plantations of Kerala'*.

Dr. R.V. Varma attended the National Seminar-cum-Workshop on Honeybee diseases, their diagnosis and management from December 6-9, 1994 at the University of Agricultural Sciences, Bangalore.

Dr. R.V. Varma attended the National Workshop on Termite Control during February 20-21, 1995 at the Central Building Research Institute, Roorkee, UP and presented a paper *'Evaluation of newer termiticides for eucalypt plantation establishment'* (Varma, R.V. and K.S.S. Nair.)

Invited Talks

Dr. Balagopalan gave three lectures on *'Basics of soil chemistry'*, *'Methodology in monitoring soil pollution'* and *'Impact of clearfelling forests on soil ecosystem'* for the Refresher course in 'Instrumental Methods in Environmental Monitoring' organised by the School of Environmental Stud-

ies, Cochin University of Science and Technology, Cochin on November 18 and 19, 1994.

Dr. K.M. Bhat gave lectures and conducted wood anatomy practicals for State Forest Service Officer trainees during February 6-16, 1995.

Dr. P.S. Easa was invited to be a Resource Person and gave a talk on *'Biodiversity in Kerala'* in National Seminar for Young Environmentalists organised by Jawahar Bala Bhavan at Periyar Tiger Reserve, Thekkady from September 23-25, 1994.

Dr. R. Gnanaharan gave guest lectures to the participants of Refresher Courses at SFS College, Coimbatore on October 20, 1994; January 19 and February 23, 1995.

Dr. R. Gnanaharan gave guest lecture at IPIRTI, Bangalore on November 16, 1994.

Dr. R. Gnanaharan gave lecture-cum-demonstration on bamboo preservation to the artisans of Tripura at Agartala during 24-26 November 1994.

Dr. K.K. Ramachandran, worked as resource person for the National Seminar of Young Environmentalists' Conference at Thekkady sponsored by Nehru Bal Bhavan during September 23-25, 1994.

Dr.J.K. Sharma, attended a pre-project meeting in CIFOR, Bogor, Indonesia during December 12-17, 1994 to finalize a collaborative research project *'Fungal pathogens as a potential threat to tropical acacias - case study of India'* undertaken by Scientists working in Australia, India, Indonesia, Malaysia, Thailand and sponsored by CIFOR and ACIAR.

Dr. R.V. Varma gave an invited talk on *'Forest insect pest problems in Kerala'* at the Dr. Y.S. Parmar University of Horticulture and Forestry, Solan, Himachal Pradesh on February 25, 1995.

Radio/TV Talks

Scientists from KFRI participated in the 'Farm and Home' programme (Malayalam) of All India Radio, Trichur. The following talks were broadcast:

Dr. Balagopalan *'Role of trees in preserving our top soil'*
Dr. C. Mohanan *'Diseases affecting our teak plantations'* on February 4, 1995
Dr. R.C. Pandalai *'Rejuvenation of degraded lands'* on December 9, 1994.

Training

Dr. Balagopalan attended the Forest Research Management Course ganised by ODA-ICFRE at IFGTB, Coimbatore during December 5-10, 1994.

Campus News

Degrees/Awards/Prizes etc.
Dr. K.V. Sankaran was awarded a Darwin Fellowship in biosystematics by the Department of the Environment, U.K. at the International Mycological Institute, U.K. from May 5, 1994 to May 4, 1995.

Mycorrhiza/NFT Reseachers meet at KFRI

A meeting of mycorrhiza/NFT Researchers, sponsored by FORSPA, Bangkok, was organised at KFRI from August 1-5, 1994. The meeting was attended by the investigators of four research projects funded by FORSPA on a Research Strategy 'Reforestation of degraded lands and problem soils'. The investigators were Dr.J.K. Sharma, Dr.M. Balasundaran, Dr.S. Sankar from India, Dr. Ngyan Duc Thang from Vietnam, Dr. Suhardi from Indonesia, Dr.U. De La Cruz from Philippines and the experts were Dr. Nicholas Malajczuk, CSIRO, Australia, Dr.D.J. Bagyaraj (UAS, Bangalore), Dr. Alok Adholey (TERI, Delhi) and Dr. Precha Wadisirisuk (Bangkok). The investigators presented their project reports and held discussions with the experts and among themselves on the methodology and results obtained. A number of suggestions were advanced during the discussions to improve the quality of research projects. The meeting was inaugurated by Dr.S. Chand Basha, Director, KFRI and Dr.C.T.S. Nair highlighted the objectives of the meeting. The meeting also identified a number of areas of research in the field of mycorrhiza and N_2 fixing symbionts which need immediate attention.

SAMPLE
Ver 1.0

Software package for statistical analysis of sample survey data

SAMPLE is a collection of programmes useful for estimating population parameters like mean, total and ration for different sampling schemes. The package covers a wide array of sampling schemes involving stratification, multistage and multiphase sampling with systematic or random sampling pattern at the final stage. It also takes care of ration or regression estimation with an auxiliary variable and performs computations associated with probability proportional to size (PPS) sampling. The programme can handle upto 3 response (main) variables at a time and has built-in data editing facilities.

SAMPLE requires a minimum of 640 KB memory and runs under DOS Ver 3.0 and above. It is completely menu-driven and involves no external commands other than the command to invoke the programmes.

The programme **SAMPLE** was developed at the Division of Statistics, Kerala Forest Research Institute. Peechi. The software is nominally priced at Rs. 2000 per copy to defer the cost of development. Interested people may make a request with a Demand Draft drawn in favour of:
The Director, Kerala Forest Research Institute, Peechi - 680 653, Kerala, INDIA.

Educational Video (VHS)

THE TEAK DEFOLIATOR

A 20 minute scientific documentary produced by the Kerala Forest Research Institute on the teak defoliator, *Hyblaea puera* (Lepidoptera), the most dangerous forest plantation pest of the Asian tropics.

Depicts the biology, and the spectacular drama of the pest population outbreaks and defoliation which no words can fully describe.

Summarises our present knowledge on outbreak causation and suggests management methods.

Available from : The Librarian, Kerala Forest Research Institute,
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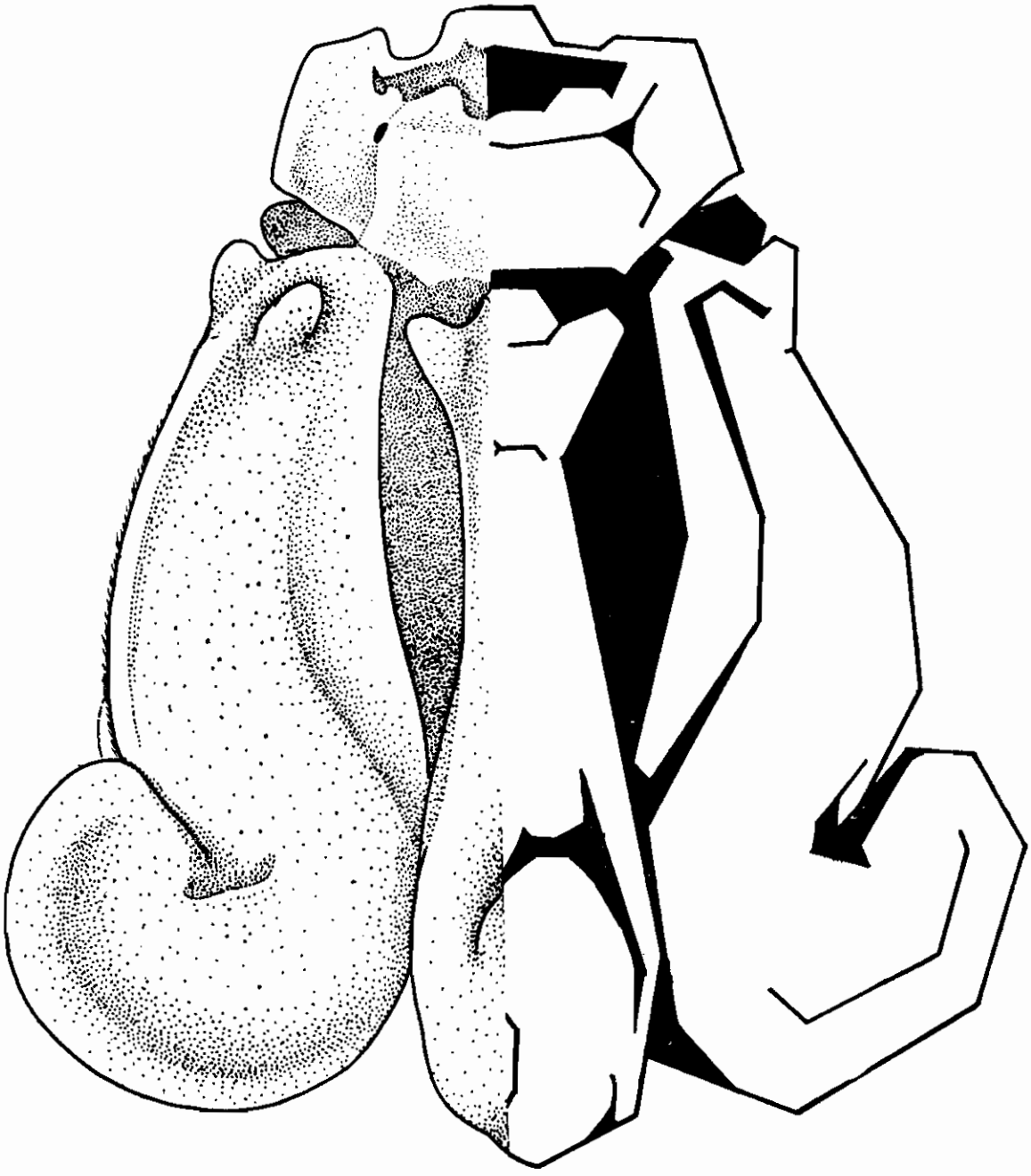

A representation of the gynostegium of *Calotropis gigantea*. From the Ph. D. Thesis of Dr. Swarupanandan, Division of Ecology, entitled 'Asclepiadaceae of Kerala' (1985).