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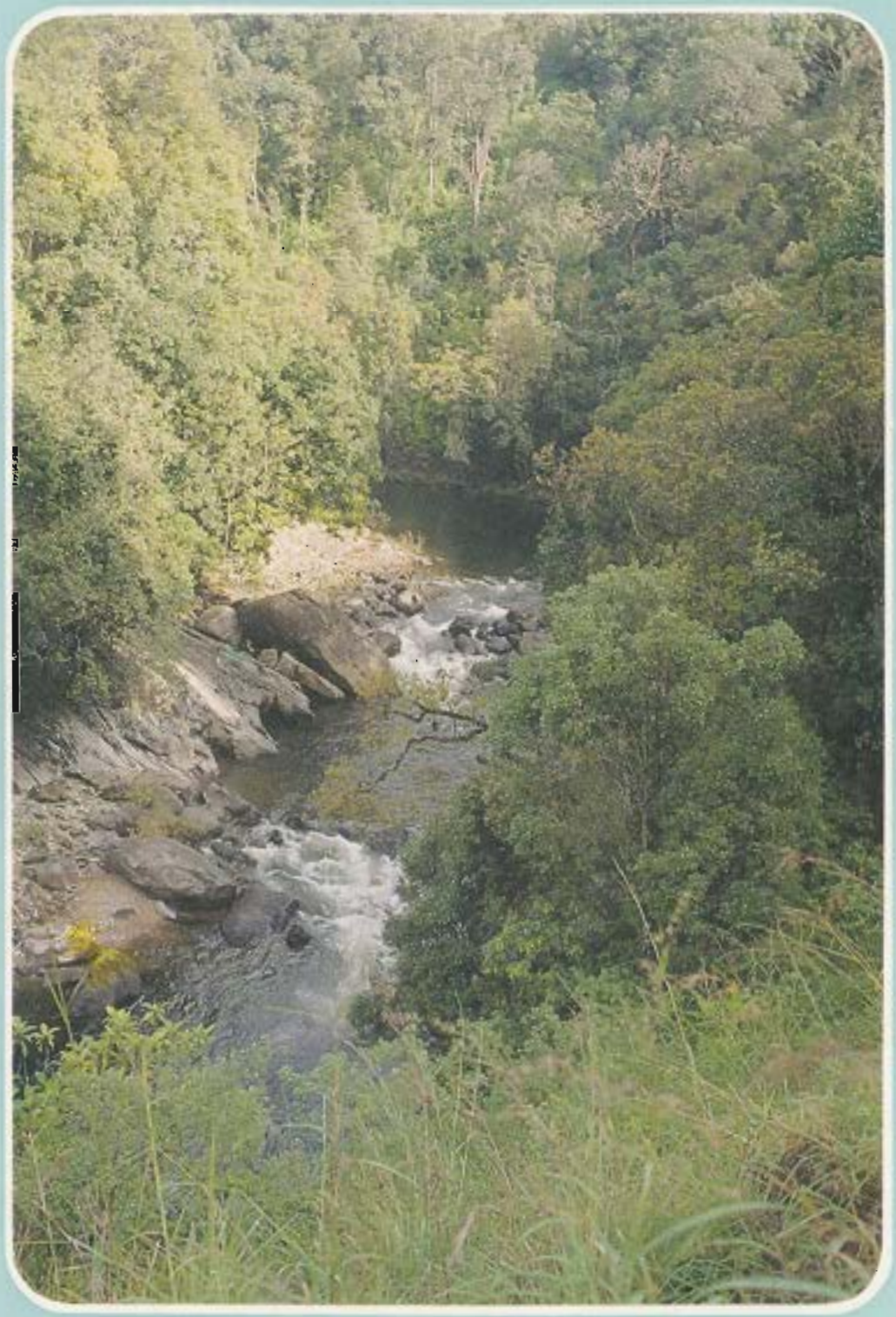

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Evergreen, the KFRI Newsletter is currently brought out in March and September each year and is intended for free private distribution within the institute and the Kerala Forest Department. Free copies will also be sent, upon request to other persons or institutions connected with forestry activities. The views expressed here are those of the authors and do not necessarily reflect views of the institute. All interested persons are invited to send comments and opinions for inclusion in the Evergreen. The Newsletter Committee reserves the right to choose among Contributions and edit, wherever necessary. Address communications to:

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Cover-Silent Valley Printed at Lumiere Photo - Subhash Kuriakose

Editor's Column

Remote Sensing in Forestry

Our natural environment, especially the forest cover is depleting day by day. Periodic monitoring of the changes that happen to our forests is essential to plan effective conservation strategies. With the advent of space era we are now able to get more comprehensive information on our natural resources such as land, water, forest cover, mineral wealth, etc., through satellite imageries and aerial photographs. This method is advantageous because of the relatively shorter time required for data collection compared to the conventional surveys.

The technology of remote sensing using satellites emerged in 1972 with the launching of Landsat-1 by the United States. The first direct application of remote sensing for resource survey began in 1978 when the U. S. launched LACE to estimate the total wheat production in the world. However, it has been pointed out by experts that remote sensing data should always be supplemented with field checking so as to get accurate information.

With the launching of the Indian Remote Sensing Satellite, IRS-IA in March this year, India has her own operational remote sensing satellite; till then we were depending on American, European or French satellites for the data. The information collected by the satellite is sent to ground stations as electrical signals and are stored in magnetic tapes. Further processing is done with the help of computers.

In this context, it would be good to think of the ways and means by which we could make use of this new tool in exploiting our natural resources judiciously. One important aspect would be to monitor the changes that occur in our forest areas. It would be worthwhile to have area-specific maps available to evolve suitable and effective management strategies. With the remote sensing facility it could also be possible to get some idea about many unpredictable processes that take place in the forests such as soil erosion, pest and disease outbreak, forest fire, etc. Thus it is hoped that this new technological development will be put to use in future for research purposes leading to better management of our forests.

The Parambikulam Wildlife Sanctuary

There are twelve wildlife sanctuaries and two national parks in Kerala. Parambikulam wildlife sanctuary, situated in the Palghat District (76° 35' and 76° 50' E and 10° 20' and 10° 26' N) covering an area of 285 km² at about 600 msl. is the third largest among the sanctuaries in Kerala. The sanctuary is bordered by Indira Gandhi Wildlife Sanctuary of Tamil Nadu on the east and the forests of Nelliampathy, Vazhachal and Sholayar on the northwest, west and south respectively. The vested forests of Nemmara border the northern side.

Parambikulam has a diverse habitat of evergeen and deciduous forests, grassland and plantations. Teak is the main man-made plantation in the area. Kannimara teak, the oldest natural teak in the world is also located here. Bamboo regeneration areas and profuse grass growth even in plantations provide food for a variety of wild animals. The fruit bearing trees and the thick undergrowth have enriched the bird fauna in this area.

Gaur with calf

Parambikulam wildlife sanctuary came into existance in 1962 with an area of 69.8 km² and more areas were included to this during the year 1973. About 28 km² of the areas are under the three reservoirs of the Parambikulam-Aliyar Project constructed in 1960. The tribal settlements in the area include Muduva colony, Parambikulam, Kuriarkutty and Sungam.

Almost all types of larger species of mammals recorded from peninsular India are present in this sanctuary. A recent census has indicated the number of tigers to be 18. Leopards are commonly seen. Elephants numbering more than a hundred are found in herds of 3 to 18. The most common herd size of elephants in the area is 11. The number of tuskers are more in Parambikulam compared to other sanctuaries in Kerala. The presence of water sources also attract herds of elephants

in summer from the drier zones of the adjacent Indira Gandhi Wildlife Sanctuary.

The most magnificant animal in this sanctuary is the Gaur, about 1000 in number. Herds of upto 30-40 numbers with calves are usually seen during the months from August to December.

Among the deers, sambar and spotted deer are very common in the sanctuary. In addition, barking deer and mouse deer are also seen.

The four primate species in tne sanctuary are Bonnet macaque, lion-tailed macaque, Nilgiri langur and common langur. The evergreen forests of Kuriarkutty, Karappara and Shettivara hills are known to be the important habitats of monkeys in this area. King Cobra, Python and other snakes are seen in the sanctuary.

The three reservoirs of the Parambikulam-Aliyar projects (viz., Parambikulam, Thunakadavu and Peruvarippallam) harbour a small number of crocodiles and probably remains to be the only place in Kerala to see them in wild.

The sanctuary is not connected by road from Kerala, which reduces the human pressure in the area. People with genuine interest in wildlife only visit the sanctuary. A possible threat to the sanctuary is the proposed Kuriarkutty-Karappara project which will submerge the feeding ground of many animals in the sanctuary. With strict control over the 'developmental' activities and addition of the adjacent forest areas of Vazhachal, Sholayar and Nemmara to the sanctuary, Parambikulam would probably become one of the finest wildlife sanctuaries of our country.

P. S. Easa
Division of Wildlife

Weather Station at KFRI

A weather station has started functioning in KFRI recently. This station is located in the main campus of the Institute at Peechi (latitude: 10°32'N; longitude: 76°20' E; altitude: 45 msl). The data are collected daily and recorded. The following weather parameters are monitored using the instruments mentioned against each.

Temperature	—	Max. and Min. thermometer
Relative humidity	—	Wet and dry bulb thermometer and hygrograph
Rainfall	—	Ordinary rain gauge
Wind speed	—	Cup counter anemometer
Bright sunshine	—	Campbell-Stokes recorder

The weather station is set up mainly for the use of researchers within the Institute. The daily weather data are displayed on a board in KFRI. Apart from this, the data are also being fed into a computer. It is now possible to supply a hard copy and if necessary, copies of the data disks. These facilities can also be made available to actual users of the weather data outside the Institute.

Diseases of Forest Trees in Kerala

4. Dalbergia latifolia

Rosewood (*Dalbergia latifolia* Roxb.), a large deciduous tree, occurs scattered in mixed deciduous forests of Western Ghats; occasionally, it is found gregarious in patches. Regeneration of *D. latifolia* is quite common through root suckers. Attempts to raise rosewood in plantations have not been very successful due to various reasons.

A disease survey conducted during 1982-1985 in plantations at Kannoth and Begur, a regeneration plot at Begur and several isolated saplings as well as trees in various localities of Kerala has revealed the occurrence of four diseases, all affecting the foliage. No stem decay fungi such as *Polyporus gilvus* and *Ganoderma lucidum*, reported from other parts of India, were observed in Kerala.

DISEASES

All the four foliage diseases recorded on root suckers, saplings and mature trees are new disease records for *D. latifolia*.

1 Physalospora leaf spot

Causal organism: *Physalospora dalbergiae* sp. nov.

Occurrence: Though this disease was recorded throughout Kerala it was found to be more common in northern parts. The leaf spots usually appeared in September/October just after the South - West monsoon.

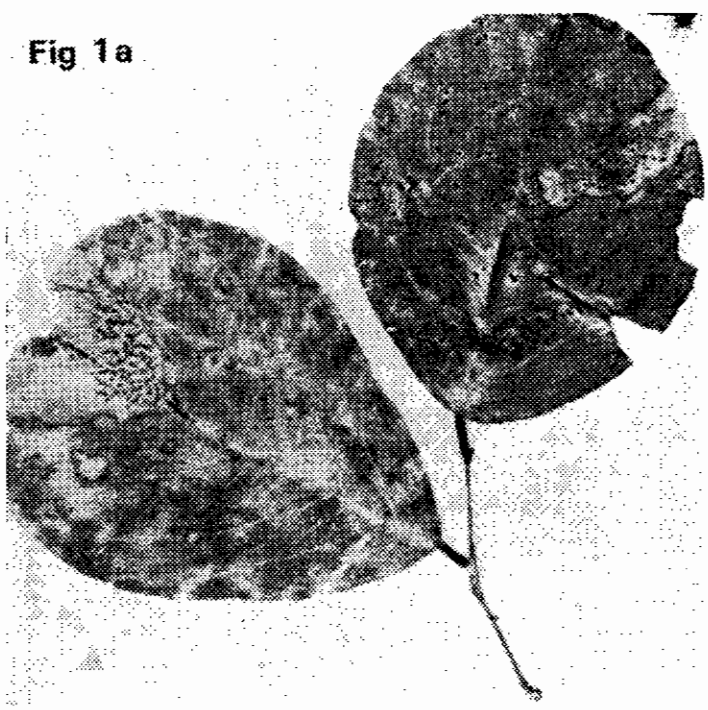


Fig. 1a. Leaflets showing dual infection by *Physalospora dalbergiae* sp. nov. and *Phyllachora dalbergiae*.

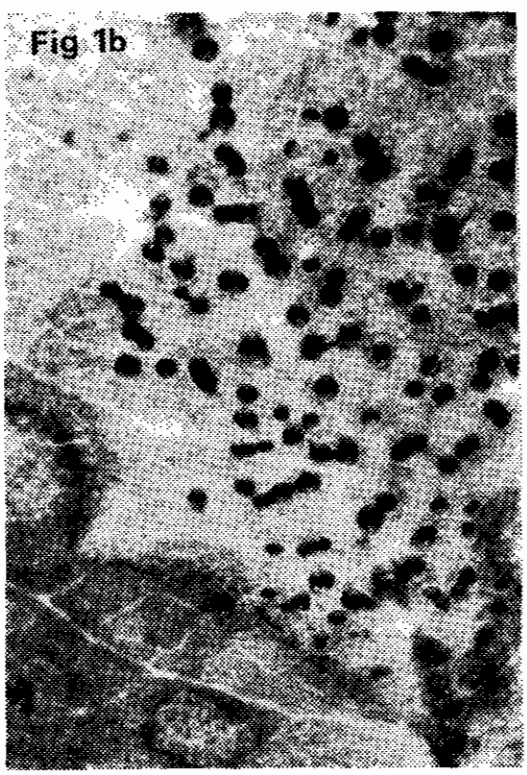


Fig. 1b. A magnified view of a leaf spot caused by *Physalospora dalbergiae*.

Symptoms: Leaves of all the ages were found to be susceptible to infection. The leaf tissue of the affected area became yellowish-green and gradually turned into an amphigenous necrotic spot. Black, shiny dot-like ascomata developed in groups on the adaxial surface of these spots. In severe cases five to eight such leaf spots could be present on a single leaflet (Figs. 1a, b).

Control measures: Common fungicides (Dithane M-45, Captan and Fytolan) have been found to be effective in controlling *Physalospora* diseases.

2. Phyllachora leaf spot

Causal Organism: Phyllachora dalbergiae Niessl.

Occurrence: The disease was recorded mostly in Wynad plateau at Thettroad, Begur, Periya, Chethaleth and Mavinhalla and Peechi. The incidence of the disease was very low and it usually occurred along with Physalospora leaf spot.

P. dalbergiae has earlier been recorded on *Dalbergia sissoo* from Calcutta and Pusa, Bihar. This is the first record of its occurrence on *D. latifolia*. Since this disease is uncommon and occurs in low incidence, it appears to be unimportant.

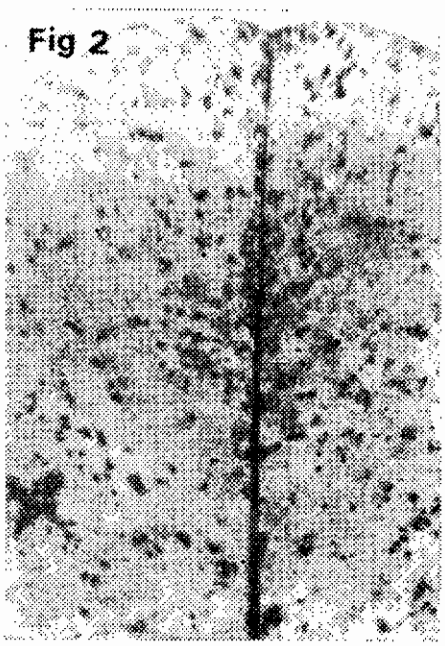


Fig. 2. A part of leaflet severely infected with leaf rust, *Uredo sissoo*.

Symptoms: Initially, yellowish-green flecks developed on the upper surface of leaves, where shiny black, cushiony ascomata developed singly or in clustures (Fig. 1a). The affected area of the leaf turned pale and gradually to light brown colour.

3. Leaf Rust

Causal organism: Uredo sissoo Syd. & Butler

Occurrence: The leaf rust was widespread and observed during October-April. Premature defoliation due to severe rust infection on root suckers was recorded at Vattappoil, near periya. This is the first record of *U. sissoo* on *D. latifolia* from India. The rust may be of serious concern only in young root suckers where it causes some premature defoliation. In general, the disease appears to be of minor importance.

Symptoms: Minute, sparsely scattered uredeniosori, (Fig. 2) rusty brown in colour, appeared during October/November on the abaxial surface of leaflets. Only in the case of severe infection some light greenish yellow flecks developed on the adaxial surface. Severely rusted leaflets turned yellow and got defoliated prematurely.

4. Colletotrichum leaf spot

Causal organism: Colletotrichum state of *Glomerella cingulata* (Stonem.) Spauld. & Shrenk.

Occurrence: The disease was recorded during the South-West monsoon (July-September) in Wynad Plateau at Chethaleth and Begur, Peechi (Kerala For. Res. Inst. Campus), Kottappara and

Fig. 3. Colletotrichum leaf spots which result in shot-holes.

Pezhad (Malayattoor Div.). Severe infection caused considerable damage to the leaves by forming shot-holes; premature defoliation was observed occasionally. Colletotrichum leaf spot is a new disease recorded for *D. latifolia*.

Symptoms: Young as well as mature leaves were equally susceptible to infection. Small brown amphigenous necrotic spots, 1 - 2 mm across, appeared scattered over the leaflets, but commonly along the margin and near the tip. Later, these spots coalesced to large irregular reddish brown spots surrounded by light greenish yellow border. The necrotic tissue was often shed leaving shot-holes in the lamina (Fig. 3).

J. K. Sharma
E. J. Maria Florence
C. Mohanan
Division of plant pathology

Information Service on Agroforestry

ICRAF provides information services on agroforestry in a variety of forms. The services include question-and-answer service and literature search service. ICRAF also produces a number of publications, a list of which is available from the Council.

The ICRAF library contains nearly 13,000 titles dealing with agroforestry. A computerised catalogue is available to provide access to the library. Search results are printed out and sent free of charge. The Information and Documentation Unit of ICRAF also has access to the 'AGRICOLA' agricultural database of the National Agricultural Library of the U. S. A.

Those who wish to obtain ICRAF library services or know more about ICRAF may write to:

HEAD
Information and Documentation
ICRAF
Post Box No. 30677
Nairobi, KENYA

History of Forest Management in Kerala

Kerala Forest Research Institute has taken up a study on the history of forest management in Kerala with the following objects:

— to analyse the development of different silvicultural systems during various periods in Kerala.

— to record the changes with regard to intensity of management.

— to identify the general trends in forestry taking into account changes in allied sectors such as agriculture and industry.

The major issues that will be taken up include (1) what have the working plans sought to achieve and how effective were those in regulating forest land use and forestry operations, (2) what are the factors that have contributed or determined forest land use changes, (3) the dynamics of forest utilization and occupation in different areas and (4) what has been the role of public sector agencies and industries in forest use and modification?

The collection of data is divided into 4 periods viz., prior to 1860, 1860-1940, 1940-1956 and from 1956 to 1980. The data on the activities of the Forest Department and forest based corporations, as reported in the annual administrative reports during the period 1956-1980 are being collected and analysed.

Along with the writing up of the history of forest management in Kerala we plan to build up a collection of oral history in casettes by interviewing forest officials, contractors, tribals and others who were involved with the forests. This oral history collection would bring out the perspective of different groups as well as the change of focus during different periods. This will also preserve details which cannot be accommodated in a report and would serve as a bench mark for future references.

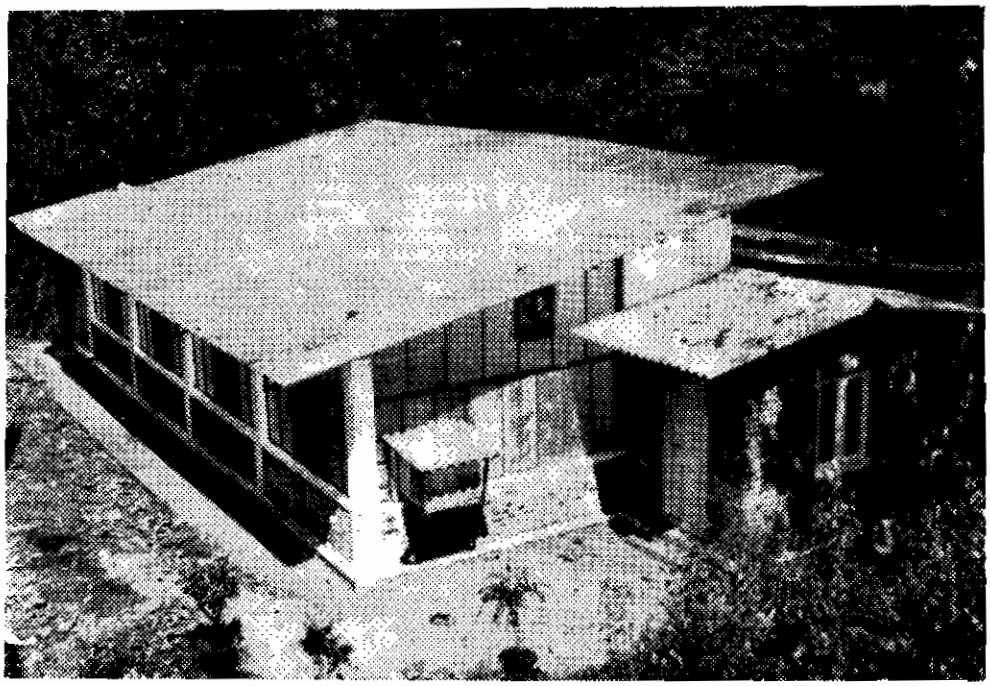
We seek your help in locating and interpreting the available evidence on forestry and forest management in Kerala. The nature of help solicited include: 1. Providing information on the existance of documents/written evidence relating to any aspect of forest use, 2. Identifying individuals who were involved in the planning and implementation of particular schemes, and 3. Identifying areas or regions which have a different history or which is an exception to the general rule. We welcome your valuable suggestions in this regard. Your help would be appropriately acknowledged.

Mammen Chundamannil
Division of Management

Jhumming— For centuries, tribals inhabiting the mountainous northeastern region in India have been practising a wasteful, destructive and labour intensive mode of agriculture called "Jhum". The time gap between two consecutive slash-and-burn events has reduced to 2-3 years from 20-30 years. As a result the dense forests are being denuded rapidly.

Mist Chamber Facility at KFRI

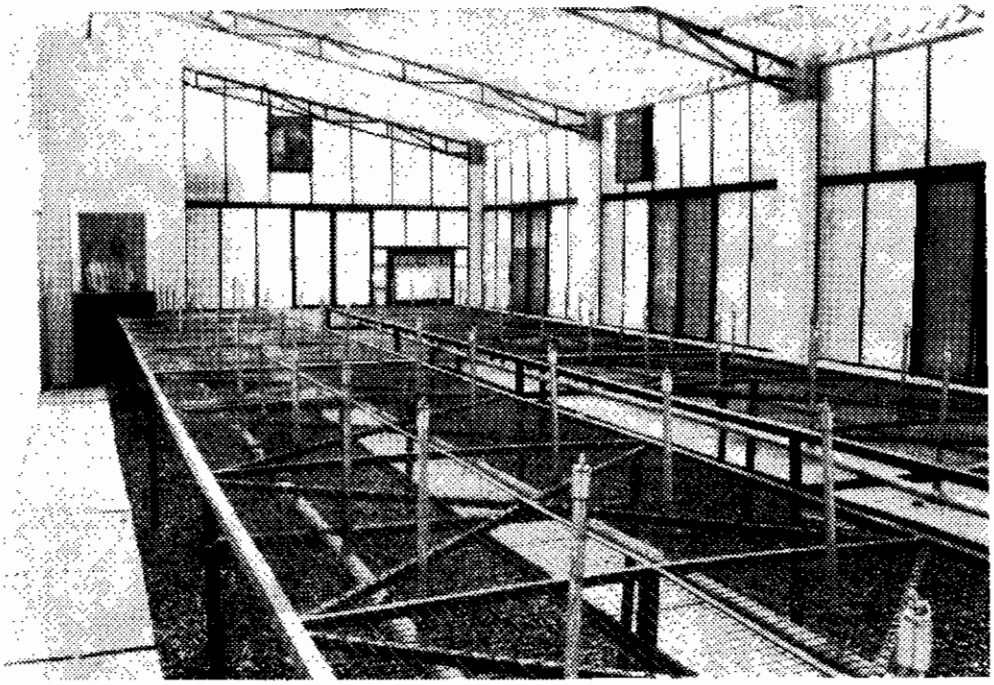
Trees, unlike agricultural crops, have been difficult to improve genetically, because of their long generation times and prevalence of out-breeding. Although some genetic gains have been achieved by tree-breeding, improvement in yield and form is generally through selection of provenances. Recently, however, there has been a growing interest in using the technique of clonal propagation and in exploiting the considerable amount of genetic variation present within the existing populations.



Mist Chamber — An outside view

This interest has arisen from the increasing number of tree species that have been found amenable to vegetative propagation, and the realization that clonal selection provides an opportunity to harness and exploit genotypic variation directly. Besides, clonal propagation technique can be used for large-scale multiplication of economically important trees such as bamboo, reeds, canes, etc., having irregular seeding habits, long flowering and fruiting intervals, poor seed setting leading to poor germinability of seeds and short and long periods of seed dormancy. Thus, this technique allows some of the biological problems hindering reforestation with tree species to be circumvented. Clonal propagation could also make investment in forestry more attractive by increasing yields and quality, and shortening of rotations.

For pursuing research in clonal propagation, a modern mist chamber facility has been commissioned recently at KFRI. The facility has two separate units. The main one is the mist unit equipped with (i) nozzles over the work benches to produce fine mist for timer-regulated period and interval, (ii) air conditioners for maintaining desired temperatures during experimentation, (iii) regulated lighting system, and (iv) fibre glass roofing to allow about 75% of the sunlight to pass through in the chamber. Adjacent to the mist unit is the hardening unit provided with work benches where rooted cuttings



Mist Chamber — Interior view

will be transferred for hardening, before transplanting them outdoors. This unit also has a few mist nozzles regulated with a timer to provide mist during the first few days of transfer of rooted cuttings. Both mist unit and hardening unit are also equipped to carry out hydroponics. Since mist is required continuously during the experimentation the mist chamber facility has been provided with a back up generator for automatic starting of the generator in the event of a current failure.

Experiments on clonal propagation of different species of bamboos and disease evading plus trees of eucalypts are to be initiated soon by the Plant Physiology Division.

J. K. Sharma
Division of plant pathology

Studies on Lepidopteran Fauna of Silent Valley

Insects which outnumber all other animal groups in terms of the number of recorded species, have a significant role to play in any ecosystem. The insect life is also closely linked with the diversity, abundance and distribution of plant communities in a given area.

Among the various groups of insects, Lepidoptera which include butterflies and moths, have become popular objects for study. Moths and butterflies are economically important because the larval stages of many lepidopterans feed on the foliage/shoots of a number of trees and crops. They also act as pollinators, thus helping in the dispersal of plants. However, the diversity and composition of this group of insects will depend on the vegetation. Any change in the habitat is likely to affect the relative distribution and abundance. Many lepidopterans are highiy host specific and there are 'indicator species' for specific habitats. Moth sampling has been reported to be useful in monitoring environmental changes in the forest. The tropical rain forest is known for species diversity, but we lack information on these aspects.

The order Lepidoptera ihclude about 75 families and the taxonomy of most of the familiies is poorly understood. Also the interrelationships of flora and fauna needs to be investigated. It was in this context that a study has been undertaken in the Silent Valley National Park with the following objectives:

— to collect basic information on the lepidopteran fauna of Silent Valley and to study their diversity and role in the ecosystem.

— to gather information on species that are endemic to this area and to suggest conservation strategies with respect to endangered species, and

— to examine the feasibility of using them as biotic indicators for monitoring changes in the environment.

This is a research project under Nilgiri Biosphere Research Programme of the Department of Environment and Forests, New Delhi.

George Mathew
Division of Entomology

Fighting the green house effect with trees

An American power company has agreed to plant 52 million trees in Guatemala to absorb the amount of carbondioxide that will enter the atmosphere from a new thermal power station it is building in the U. S. The power station will emit 3,87,000 tonnes of carbondioxide each year. It is believed that as the Gautemalan trees grow, they will absorb at least as much carbondioxide from the atmosphere and store the carbon on wood or in soils.

Water Use of the Plants in the Tropics

When talking about tropics, it is usually assumed that they are wet, warm and humid zones of the world with abundant water. Although water may not be a limiting factor in most of these areas, the temporal and spacial availability and distribution of water has a profound influence on the survival and growth patterns of plants. It should be pointed out that very little data are available on the water relations of the plants in the tropics.

One of the serious drawbacks with the rainfall in several tropical zones is its non-uniform distribution. For example, the annual average rainfall in Kerala is approximately 3000mm. However, the temporal distribution is not uniform as can be seen from table 1.

Table 1. Temporal distribution of rainfall in Kerala in a normal rainfall year.

Months	Rainfall (mm)	% of the annual total
June-September	2010	66
October-November	500	17
December-February	90	3
March-May	410	14

Let us examine how does this temporal non-uniformity affect the water consumption of plants. If we assume that the temperature and sunlight are favourable for growth during the rainy months, what happens to the water? Since the water is abundant in the soil, plant roots are able to absorb water without much resistance and the water moves up through the xylem and finally gets lost in transpiration. Although the stomata are fully open at this time due to abundant sunlight, the amount of water lost in transpiration is rather low because of the high atmospheric humidity. Transpiration is to a great extent controlled by the vapour pressure differences between the leaf and the atmosphere. The direct evaporation of water from the soil is also considerable at this time.

In the foregoing paragraph we have looked at the consumption of water by plants when water is plenty. In an area with a nonuniform rainfall pattern, this is not always the case. As the rainfall retreats (see table 1 for Kerala) the soil starts becoming dry progressively. This will be assisted by the high temperatures and the high velocity wind. Fortunately, it is the surface of the soil which becomes dry first, and forms a crust preventing loss of water from deeper layers by evaporation. It is because of this surface evaporation of water that the shallow rooted plants start drying np. Does this mean that the deep rooted plants, especially the trees are safe? It must be mentioned that most plants in the tropics are broad-leaved mesophytes which cannot stand prolonged droughted condition and hence they resort to mechanisms by which the available water is used most judiciously for their leaves so that water loss by leaf transpiration is prevented. At the same time, their roots are well protected by a wet soil which prevents any dessication injury. Root pressure might be playing a major role at this time to keep the aerial parts alive.

How does the evergreen species behave at this time? This is a subject least studied and especially with respect to their water consumption. It is possible that many of the evergreen species have good stomatal control mechanisms preventing the uncontrolled loss of water. Since the sunlight is plenty in the tropics, especially when the rainfall is less, it is very conducive for stomatal opening. However, the stomata is a much more complex apparatus than a mere opening. The stomatal opening is controlled by a number of external factors like the atmospheric humidity, water potential of the plant and soil water availability.

Although it is assumed that the relative humidity in the tropics is very high, there are times when it falls surprisingly low. If the water-loss from the stomata is controlled by vapour pressure difference

between the leaf and the atmosphere, most of the water from the plant is lost when relative humidity falls. However, practically it does not always work like that. With the fall in humidity, the turgidity of the stomatal guard cells is also lost, and at a threshold level, this could effect complete stomatal closure. Indeed, threshold level could vary between species, and it will be interesting to study this in the vast number of tropical species.

The availability of water in the soil can also control the stomatal apparatus indirectly. In understanding this, it is important to treat the whole system as a soil-plant-atmosphere continuum. When the soil water is depleted, that is, when there is no input of water by rainfall, highly negative pressure is developed in the xylem to pull up the water. Certainly the magnitude of this pressure has to be estimated in most of our tropical species. This negative pressure will consequently reduce the water potential of the leaf, which means a reduction in the turgor pressure of the leaf cells also. This will thereby induce the stomatal closure. It appears from these chain reactions that the evergreen species could be having an inbuilt capacity to survive a brief drought. However, it is doubtful if many of them can survive prolonged drought. We have no knowledge about their osmotic adjustment, which is the usual mechanism in plants to withstand drought.

Before concluding this discussion, it is timely to mention the impact of a species, which has no stomatal control, on the soils of tropics with non-uniform rainfall. Excessive transpiration will certainly dry up the soil and the plant's roots should travel deeper in search of the ground water table. These are problems which need a lot of investigations. The diversity of plant species in the tropics make research into their water consumption extremely interesting. Studying the internal water relations of the plant coupled with the microclimate analysis can unravel many interesting aspects of the water use in plants of the tropics.

Jose Kallarackal
Division of Plant Physiology

Sunderlal Bahuguna — A fighter for the cause of environment and he fights in a manner akin to Mahatma Gandhi. He advises the younger generation — "I am growing old and cannot even carry my own back - pack now when I climb heights. Younger people must now come forward to save our land"

Prevention of Wildlife Damage to Crops

Wild animals like elephants, sambar, spotted deer, wild pigs, monkeys and nilgai often cause damage to crops grown adjacent to the natural forests and also to forest plantations. Several methods have been employed by wildlife managers and crop owners to prevent such damages. These methods have been broadly classified as follows:

— Biological methods
— Mechanical means
— Frightening devices and use of repellents
— Electrical methods

Under the biological methods, a preferred crop of the wild animal is cultivated in nearby areas to lure them away from the crops to be protected. Mechanical methods involve erection of barbed wire fences, chain link fences, trenches and construction of walls. Frightening devices such as use of crackers to scare away the animals and use of repellant chemicals are also being used. However, except the electrical methods, all other methods may not be very effective.

In the past, barbed wire fences were erected with A. C. current to prevent entry of wild animals to farmland, but this method was found fatal to both animals and human beings. However, recently developed electric fences, serve as more of a psychological barrier, by giving a short but safe and non lethal shock. Once the animals experience this, they will not dare to go near it for a second time.

The mechanism of the working of the electric fence is as follows. Energiser is the heart of power fencing. This equipment will emit pulsating current of 5000 volt in every 3/10 of a second. The lag between the energy pulses allows the animals to withdraw from the fence after receiving the shock. The energiser has to be set up with its earth or ground terminal, coupled to an adequate earth

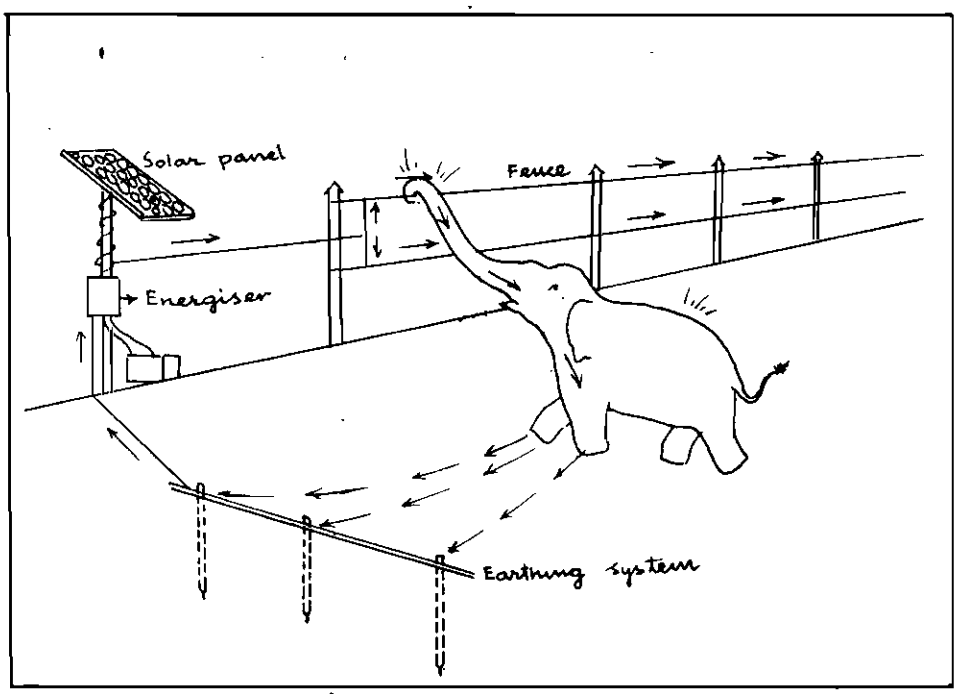


Fig. 1. Mechanism of working of an electric fence

system with 2.5 mm or 4 mm galvanised wire. Any animal that touches the live wire in damp conditions or the live and earth wire in dry conditions will get a shock. The more severe this shock, the more lasting the memory of it thus warning the animal to move away from the fence in future. Energisers can be powered from battery, A. C. current or from solar panels (Fig. 1).

Presently power fences are being used against elephant, deer, wildpig. tiger, leopard, monkey, rhino and livestock in India. Separate designs are required for each animal. A simple fence against elephants will have a single strand of wire at a height of 150 cm. This can be further modified by adding one or two more strands to make the fence more efficient in preventing entry of elephants.

Fences to check the entry of deer, like sambar and nilgai usually contain six strands at a distance of 30 cm apart. Five strand fences are used against wild pigs at a gap of 5, 20, 35, 50 and 70 cm. This will be also useful in preventing porcupines. The design of fences is fixed depending on the nature of terrain and behaviour of animals.

At Dudhwa National Park (U. P) power fences are used to keep the re-introduced rhinos at a particular habitat. In Dalma Wildlife Sanctuary and Palamavu Tiger Reserve (Bihar) the power fences are being employed to keep the elephants away from the crops. In Kerala, at Parambikulam wildlife Sanctuary, electric fences have been erected to prevent the wild animals from accidental fall into the deep canals. Currently power fences are also being used to protect rubber estates, adjacent to forests from wild animals.

The advantages of the power fences are that they can be cheaply constructed with light materials and can prevent entry of a variety of animals, both big and small. Power fences also lasts long because of the minimum physical pressure that they receive from the animals.

E. A. Jayson
Division of Wildlife Biology

" For reasons of ethics and self-interest, we should not knowingly cause the extinction of a species".

— World Conservation Strategy

Rattan Interaction Meeting

A one-day Rattan Interaction Meeting was organised by the Kerala Forest Research Institute on June 8, 1988 as part of the activities under a project sponsored by the International Development Research Centre (IDRC), Canada. The objective of the meeting was to exchange ideas and strengthen co-operation among different institutions concerned with rattan development programme.

The meeting was attended by 38 participants and included representatives from the Kerala and Karnataka Forest Departments, Field Administrative Cell for Bamboo and Cane, Marketing and Service Extension Centre of the Office of Development Commissioner (Handicrafts), Khadi and Village Industries Board, Rattan Processing and Exporting agency and KFRI.

Dr. T. G. Alexander inagurated the meeting on behalf of Director, KFRI. In his opening address, Dr. Alexander stressed the need for paying attention to indigenous resources, particularly bamboo and canes in forestry as they are part of culture in this region. He added that any programme of conservation and augmentation of these resources will ultimately help to manage the important natural resources of the country.

In reviewing the scope of the current research project on management and utilization of rattan resources in Kerala, Dr. K. M. Bhat, Co-ordinator of Rattan project called for closer co-operation from different institutions like Forest department, rattan based industries, Development Commission and research organizations in order to effectively transfer the technology to practising foresters and rattan based industries.

The speakers, who contributed substantially in formulating the future rattan development programme included M/s. T. K. Raghavan Nair, S. John Koilparambil, Mehar Singh (Kerala Forest Department), A. C. Lakshmana, M. H. Swaminathan (Karnataka Forest Department), T. S. Venkatesha and V. S. M. Namboothiri (Office of the Development Commissioner), K. V. Sreedharan (Khadi and Village Industries), P. Balakrishnan (Cane Furniture Manufacturer) and A. P. Rafeeque (Cane exporter).

Major points of interest that emerged during the interaction meeting were as follows :

— Canes are valuable resources but scarce and neglected. In view of the increasing demand for industrial raw materials, immediate attention should be given to planting of canes in suitable areas, including homesteads or marginal lands, in order to augument the resources. To renew the raw material supply to small-scale units, as a short term measure, the existing ban on extraction may be relaxed at least in areas where harvestable canes are available. Further, cultural practices such as tending and fertilizer application should be tried in existing stands for better yield of canes.

— In order to promote the plantation programme, social forestry / farm forestry schemes should consider extention activities and subsidies like free supply of suitable rattan seedings.

— Besides taxonomic work, physiological and genetic studies be initiated to enhance the growth rate and evolve fast growing species, so as to reduce the period of harvesting cycle.

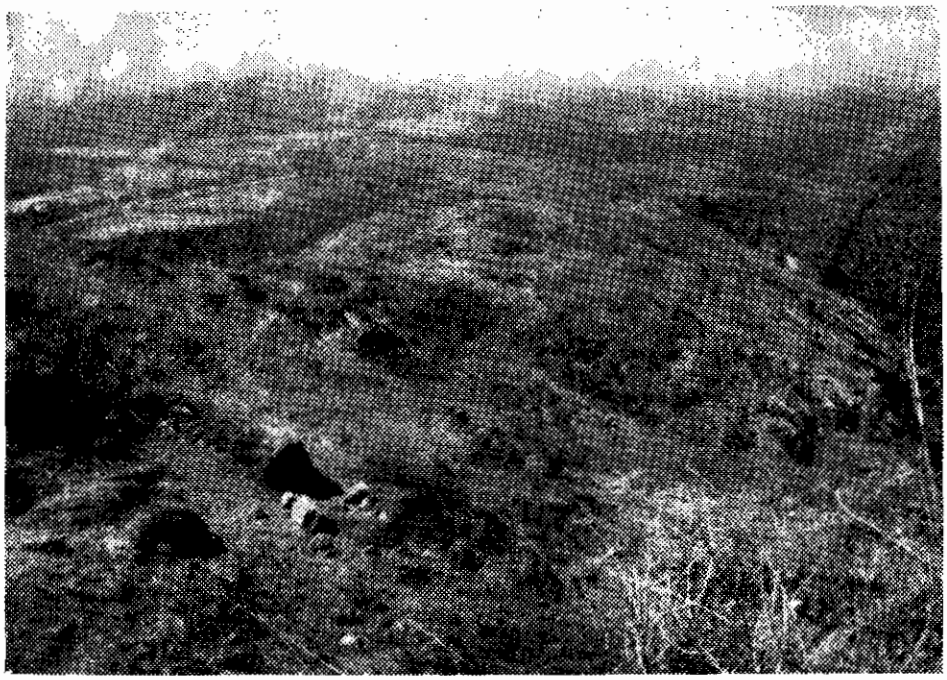
— Silvicultural studies should be intensified to develop and standardise regeneration and plantation techniques.

— In order to minimise the loss of material and meet the quality requirements of both domestic and export markets, appropriate technologies should be developed not only for protection against biological degradation but also for harvesting, processing and conversion. KFRI should also investigate the quality differences of canes being supplied from different parts of the country in terms of both stem anatomy and processing methods.

— Market studies should be carried out to solve the marketing problems, particularly those of artisans who are in the clutches of middlemen.

K. M. Bhat
Co-ordinator (Rattan Project)

Reforestation of Pattikkad Hill



The barren hill top of Pattikkad

The Pattikkad hill, on the northern side of National Highway 47, about 16 km from Trichur on the way to Palghat is situated in the Pattikkad range of Trichur Forest Division. This hilly area has been lying barren for years, mainly due to human activities of the extreme level. With a view to reforest the area, KFRI has taken up a project to test and select suitable, indigenous tree species. During this year initial trials have been launched and more than 10,000 seedlings belonging to different species were planted up in one of the hills over an area of about 10 ha. This laborious task was accomplished with the co-operation from staff of KFRI, local people and school children.

It is expected that the first year trials will yield useful data on the performance of various species and also on the biotic or abiotic factors that would crop up while restoring badly degraded forest areas. Tree species that come up well in this area will be planted in large-scale during the next planting season.

N. G. Nair
Division of Botany

The Exotic *Leucaena* Killer *Heteropsylla Cubana* Arrives in Kerala

The fear has turned a reality. Over the past few years, a tiny insect pest of leucaena, of Latin American origin, has been spreading to other countries where the plant was introduced - Indonesia, Malaysia, Thailand and Burma in our neighbourhood. It was noticed in Tamil Nadu in February this year. And now it is in Kerala The question is, whether to control the insect or to destroy the plant.

For India, the story begins in March 1987. Let's look at a few landmarks.

31 March 1987

Mr. A. G. Oka, then Additional Inspector General of Forests, Ministry of Environment and Forests, wrote to Dr. P. K. Sen-Sarma, Director, Biological Research, FRI Dehra Dun —

"It has been reported that a species of jumping plant lice, *Heteropsylla cubana* has followed leucaena plant from Tropical America to South-east Asia, Australia and Pacific Islands and away from its natural enemies psyllid populations have boomed and severely damaged leucaena plantations.....

The copies of Action Plan & Recommendations for biological and genetic control of this pest by the recently held workshop in Hawaii (3-7 November, 1986) are being sent for your perusal and necessary action.

I think there is an immediate need to keep strict vigil on this pest and initiate adequate timely measures to safeguard the leucaena plantations throughout the country as well as to start developing and multiplying pest resistant genes."

11 June 1987

Director, Biological Research in a letter to Additional IGF—

"As per report of our Forest Entomologist we have not come across any psyllid pest including *Heteropsylla cubana* damaging *Leucaena leucocephala* in India, so far..... we will also continue our efforts to detect its presence in India and to take necessary action for its control"

Director, Biological Research in a circular letter to Heads of Regional Centres at Coimbatore, Burnihat, Jabalpur and Bangalore—

".....You are, therefore, requested to instruct the Entomologist working in your research centre to keep a watch on the possible introduction of the jumping lice, *H. cubana* in your region....."

17 August 1987

Dr. C. Kempanna, Deputy Director General (CS), ICAR in a letter addressed to Director of Biological Research, FRI—

"It is feared that it may soon be introduced into India if we are not vigilant. Since leucaena is an important component of the Indian agroforestry programmes, it is essential to consider now the possible steps that may be taken to minimise the chances of its entry into India and also to prepare ourselves with a strategy to combat this menace, should the pest gain entry."

29 February 1988

Dr. S. Jayaraj, Director, Centre for Plant Protection Studies, Tamil Nadu Agricultural University, Coimbatore reported to Mr. Pratap Singh, Forest Entomologist, FRI, Dehra Dun that his staff have detected the presence of a psyllid in leucaena plantations in the University's Livestock Research Station at Kattupakkam, Chengalpettu District.

This was the first record of a psyllid pest of leucaena in India.

15 March 1988

Mr. Pratap Singh, Forest Entomologist, FRI, Dehra Dun in a letter to Dr. S. Jayaraj —

"..... I am afraid the psyllid you have recorded may be *Heteropsylla cubana*....."

23 March 1988

Dr. R V Singh, Director General, ICFRE in a circular letter to the Chief Conservator of Forests of all States and Union Territories —

"A new psyllid pest of subabul has been reported from Tamil Nadu.....The detection and spread of the psyllid pose a great danger to the crop and may prove catastrophic to leucaena cultivation. The most pressing need of the hour is:

(i) to undertake a survey of *Leucaena* plantings all over the country for detection of the pest,

(ii) to undertake immediate eradication as soon as it is detected.

If the psyllid is detected, destroy it by spraying..... insecticide..... Please use 0.04% dimecron / rogor (systemic) and 0.2% fenitrothion / endosulfan (contact) as water emulsions. Repeat the treatment after every fifteen days and monitor the pest population regularly. Don't feed the treated forage to cattle.

For preventive control we may use biological control agents like the predator, *Curinus coeruleus* or plant psyllid resistant clones/varieties. Recommendations in this regard will be made in due course of time."

April 1988

Mr. Pratap Singh, Entomologist, Forest Research Institute, Dehra Dun in an article in Indian Forester—

"The new Psyllid causing damage to *Leucaena* was identified as *Heteropsylla cubana* Crawford....."

7 June 1988

Dr. K. S. S. Nair, Entomologist, KFRI, participating in a discussion on psyllid problems of leucaena in the FAO / IUFRO Workshop on Pests and Diseases of Forest Plantations at Bangkok, Thailand —

"May be for countries like Thailand where leucaena is cultivated in extensive areas due to its importance as a component of cattle feed, it is worthwhile controlling the psyllid, but for countries like India, where leucaena has not yet become very important economically, the time and effort spent on controlling the pest is not worthwhile. The best strategy for India appears to be to uproot leucaena and burn them, and look for something better".

21 November 1988

The Silvicultural Research Officer, Trivandrum reported to the Director, KFRI on the occurrence of psyllid pests on a few leucaena trees and seedlings within the office compound of the Chief Conservator of Forests in Trivandrum.

24 November 1988

Dr. K. S. S. Nair in a note to Dr. R. V. Varma —

"I find that the leucaena psyllid has also reached our campus. I saw them on some saplings opposite to the library building. All of them are attacked and practically defoliated."

25 November 1988

Shri C. Mohanan, Division of Pathology reported the occurrence of the psyllid bugs on a few leucaena plants in Attappady (Palghat District)

* * *

Thus the suspense ended with the arrival of the pest, in less than an year. How did they arrive here? No one knows for sure. But let's look at the exploits of this tiny insect over the past few years.

The beginning

The original distribution of this psyllid appears to have been limited to the central American region. Until 1983, it was known only from this region, particularly the Caribbean region around Cuba and the east coast of Mexico.

It never attained a pest status in this region apparently because the population remained low du, to pressure from natural enemies.

The Conquest

The conquest began in late 1983. It was noticed then in Florida, outside its original range, attacking and causing die back of leucaena. By April 1984 it appeared in Hawaii. From there on the eastward movement was fast-the countries which were occupied in subsequent years are listed below (see also the Fig. 2). It has been predicted (NFTA, 88-05, 1988) that the insect will now move into Africa.

Fig. 1. *L. Leucocephala* seedling showing typical damage and the insect.

Spread of the leucaena psyllid, H. cubana

Year	*Countries*
Until 1982	Central America (around Cuba and east coast of Mexico)
1983	Florida
1984	Hawaii, Western Samoa, New Caledonia, American Samoa and Solomon Islands.
1985	The Philippines, The Cook Islands, Fiji, Nive Islands, Eastern Thaiwan.
1986	Indonesia, Java, Sumatra, Bali, Clores, Sulawesi, New Britain, Bongainville, New Ireland, Australia, Christmas Island, Malaysia, Thailand.
1987	Sri Lanka
1988	India, Burma, China

The insect and the damage

Heteropsylla cubana Crawford belonging to the homopteran family psyllidae is a relatively small insect, light yellowish in colour with hyaline wings aud measuring about 1-2 mm in size. The eggs are laid in groups on the soft tissues of the host plant. The nymphs that hatch out are pale yellowish in colour and are soft bodied. They feed gregariously on the tender stems and leaves. Under mild tropical climates the generations are reported to be continuous and overlapping. Continued feeding by the nymphs and adults may result in the defoliation of trees or cause shoot die-back (Fig. 1).

The genus *Heteropsylla* is almost specific to leucaenas. This genus, endemic to the tropics and subtropics of the new world has recently become widespread in several counties including India with the recent introduction of leucaena. Distinct species have been reported to attack this tree in the different countries. For instance, in Hawaii, *H.* sp. nr. *fusca* has been reported; *H. incisa* occurs in Dominican Republic and *H. cubana* in Cuba (Sorensson and Brewbaker, LRR Vol. v; 91-93, 1984) However, there is much confusion in the taxonomy of the variouos species belonging to this genus. Recently Burckhart (Revue Susse de Zoologie, 93 : 1023-1024, 1986) has sunk the species *H. incisa* as a synonym of *H. cubana.* The species reported to be introduced in India is *H. cubana.* In this context it may also be mentioned that an allied genus viz., *Dicoropsllya*

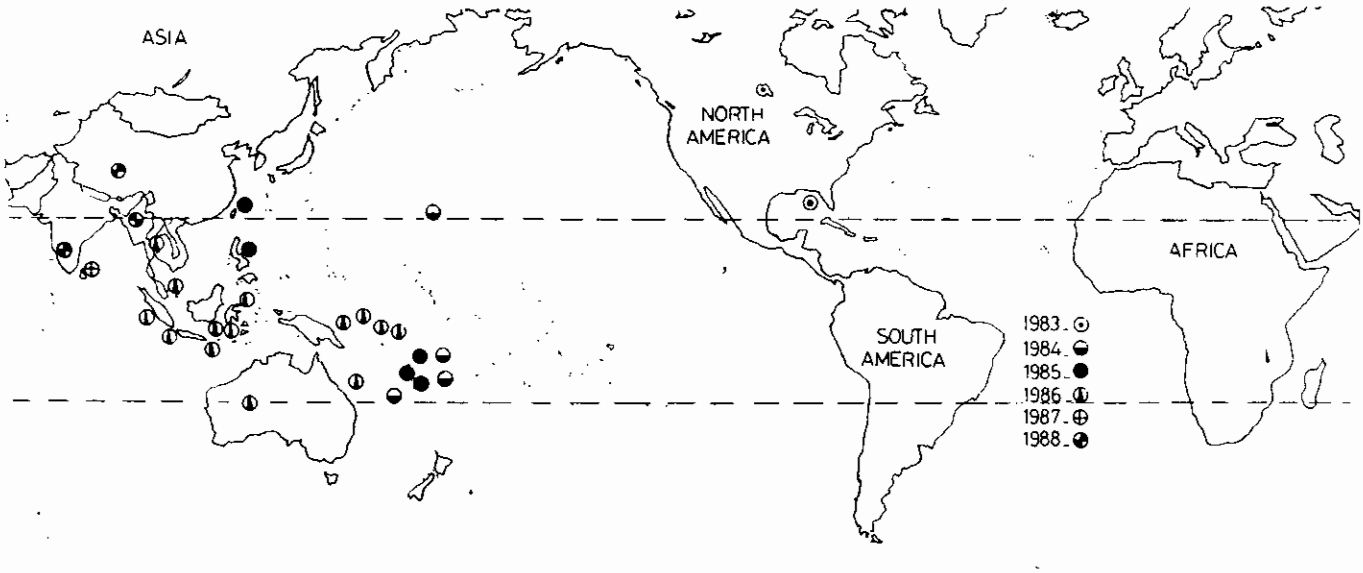


Fig. 2. Map showing the spread of the psyllid bug

occurs in India and the species collected on leucaenas needs careful examination.

Although *Heteropsylla* spp. are almost specific to leucaenas in Hawaii, it has been reported to attack *Samanea saman* and *Delonix regia*. These trees occur in several parts of India and the possibility of *Heteropsylla* spp. assuming pest status on the above trees needs to be kept in mind. Recently, species resembling *H. cubana* has been noticed to attack seedlings of *Terminalia bellerica* at Peechi (Kerala) which necessitates early measures to check the build up and spread of this insect.

Control the insect or destroy the plant?

Let's come to grips with the real situation. *H. cubana*, a serious pest of leucaena, is here. Experience with other introduced pests suggests that it is here to stay, as long as leucaena is here. We will be able to suppress its population and keep it at a low level, but we may not succeed in exterminating it. Even if we do, it can re-enter, as it did once.

Is it worthwhile controlling the psyllid? Recommendations have already been made by responsible officials — to undertake a survey of all leucaena plantations to undertake eradication measures by spraying insecticides, to introduce exotic biological control agents like the lady bird beetle predator, *Curinus coeruleus* and *Olla abdominalis* and to replace susceptible varieties of leucaena with psyllid resistant clones / varieties. Such actions have already been carried out in some countries like Thailand. There has been a recent boom of research papers, proposals and seminars on biological and genetic control of the leucaena psyllid. Economic considerations are sometimes forgotten in the enthusiasm for controlling the pest. In countries or regions where leucaena cultivation has become economically important, it may be worthwhile attempting to control the pest.

We propose here that in Kerala where the leucaena has not become a commercially important crop, we should not waste our resources in attempting to grow the plant and controlling the insect. It is not worthwhile to grow an exotic plant with the help of exotic natural enemies to control an exotic pest. This exercise may also call for exotic expertise at several stages. Let's concentrate our attention on the many underexploited native species rather than spend our energies on a few exotics.

May be these comments are applicable to other parts of the country. We invite your comments and opinion. We also invite your attention to an editorial in the March 1982 issue of Evergreen which was titled "Do we need exotic forest trees ?" and opened with a quotation, "Ipil - Ipil - The wonder ceases".

— Entomology Division

Recent Publications

Balasundaran, M. and Mohamed Ali, M. I. 1988. Effect of soil pH and Rhizobium strain on seedling growth and nodulation in *Leucaena leucocephala*. Leucaena Research Reporter 9: 42-45.

Abstract

A study was conducted to determine the effect of various levels of soil pH on seedling establishment, root growth and nodulation of *Leucaena leucocephala* after inoculating the seeds with 3 local and 3 exotic *Rhizobium* isolates. At pH 3.2, although seeds showed initial signs of germination, all of them dried within two weeks. At pH 3.7, most of the seeds germinated and 80% survived. However, seedlings were unhealthy, stunted and showed yellowing accompanied by heavy defoliation; roots were devoid of nodules and showed deformation, stunting and crowding at the collar region. Soils with pH above 4.1 and below 5.7 not only reduced the fresh weight of nodules and seedling biomass, especially at the lower pH, but also affected root growth and establishment. As the soil pH was increased, fresh weight of nodules, seedling biomass and nodule efficiency improved. The *Rhizobium* strain RCR 3817 was found suitable for soil with pH 5.7 and above; below 5.7, TAL 582 was suitable for seed inoculation. The isolate collected from Nilambur was as good as the above isolates at different pH levels statistically.

Balasundaran, M., Mohamed Ali, M. I. and Ghosh, S. K. 1988. Little leaf disease of *Eucalyptus*. pp. 47-57. In : S. P. Raychaudhuri and N. Rishi (eds.) Mycoplasma Diseases of Woody Plants. Malhotra Publishing House, New Delhi, India.

Abstract

Little leaf disease was observed in some nurseries and plantations of *Eucalyptus tereticornis* and *E. grandis* in Kerala. Attempts to transmit the disease to eucalypts seedlings though grafts and dodder were not successful. Anatomical studies showed excessive formation of phloem tissues and phloem necrosis in diseased tissue. Dienes' stain gave positive reaction with distinct blue areas under bright field. Aniline blue, a callose binding fluorochrome, showed bright yellow green fluorescent spots in the phloem tissue of little leaf diseased eucalypts. However, Hoechst 33258, a DNA binding fluorochrome gave negative reaction. TEM studies revealed the presence of pleomorphic MLO in the sieve elements in low concentration. Infusion of aqueous solution of tetracycline-HCl into diseased trees gave temporary remission of disease symptoms. The light microscopic and TEM studies and remission of disease symptom by tetracycline-HCl infusion confirm the association of MLO with the little leaf disease of *E. tereticornis* and *E. grandis* in Kerala.

Balasundaran, M., Mohammed Ali, M. I., Ghosh, S. K. and Sunderaraman, V. 1988. Presence of Sandal Spike MLO in the insect vector, *Redarator bimaculatus* and in plants fed with the vector. pp. 23-28. In : S. P. Raychaudhuri and M. Rishi (eds). Mycoplasma Diseases of Woody Plants. Malhotra Publishing House, New Delhi, India.

Abstract

Recent studies carried out in the Sandal reserve forests of Marayoor in Kerala by the authors indicated *Redarator bimaculatus* Dist., an Issid, as a possible vector of sandal spike disease. The insects collected from spiked sandal trees in sandal reserve 51 of Marayoor forest range were released on severely spiked shoots for acquisition access period of 24 to 120 hours. Of these 2 to 17 insects were released on 1-to 2-year-old seedlings raised in insect proof cages and 4-year-old trees in the field. Spike like symptoms developed after three months in seedlings whereas it took about 6 months in trees. Petiole and stem tissues from these trees showed numerous pleomorphic mycoplasma-like-organisms (MLO) in the pholem tissue under electron microscope which were comparable with the MLO observed in naturally infected sandal trees. Tissues of intestine and salivary glands of *R. bimaculatus* also showed MLO after acquisition feeding.

Bhat, K. M., Dhamodaran, T. K., Bhat, K.V. and Thulasidas, P. K. 1987. Wood property variation of 3-year-old trees among four eucalypt species grown in Kerala. Journal of the Indian Academy of Wood Science 18 : 7-12.

Abstract

Variation in wood properties among four species of 3-year-old eucalypts has been studied. The species selected were *Eucalyptus grandis, E. pellita, E. camaldulensis* and *E. tereticornis*. Wood density and bark percentage values were highest in *E. camaldulensis* and lowest in *E. pellita* while wood density of *E. tereticornis* was not significantly different from that of the former. Fibres were however, longer in *E. pellita* and *E. grandis* than in other two species while the shortest fibres were found in *E. tereticornis*. In each species fibre length increased from the pith to the bark by about 27-37%. Heartwood percentage was highest in *E. grandis* and lowest in *E. tereticornis*. Analysis of variance revealed that except in bark percentage, species-to-species variation in wood properties was significant although between - tree variation in wood properties was significant although between - tree variation within the species was not significant. Among the species, tree height was more related to the properties than dbh although consistent relationship was not found.

Bhat, K. M., Bhat, K. V. and Dhamodaran, T. K. (1988). Effect of tree age on heartwood proportion of *Eucalyptus grandis* grown in Kerala. Indian Journal of Forestry 11 : 95 - 97.

Abstract

Variation in heartwood percentage with tree age was studied in Kerala grown *Eucalyptus grandis* belonging to four age groups (3, 5, 7 and 9 years). Average heartwood percentage increased from 36.8 to 66.4 from 3-year-old to 9-year-old trees. Variation in relation to height level within the tree was greater than between - tree variation in each age class. Tree height and dbh had little influence on heartwood percentage within the age group. However, larger trees had higher heartwood content, when faster growth was due to plantation location differences, suggesting the marked influence of locality factor on heartwood percentage.

Ghosh, S. K., Balasundaran, M. and Mohamed Ali, M. I. 1988. Towards the control of mistletoe on teak through tree injection using weedicides. pp. 185-192. In: P. K. Khosla and R. N. Sehgal (eds.) Trends in Tree Sciences. Indian Society of Tree Scientists, Solan, Himachal Pradesh.

Abstract

Dendrophthoe falcata var. *pubescens* Hook. f. is one of the most destructive parasites on Teak (*Tectona grandis* L.) plantations in Kerala. Only a few isolated attempts have been made to control this parasite chemically, due to the lack of proper chemicals and technique of application. The present study deals with the development of a simple 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. Rhodamine B, a tracer dye is introduced in the xylem to trace the path of aqueous solution in the tree. Experiments have been conducted to find out the most suitable time and month for rapid uptake of aqueous solutions. Using this techniques several weedicides are tested for the selective killing of the parasite. Of these weedicides, Sencor (Metribuzin) has been found to be the best.

Mathew, G. 1988. Cossid pests of teak in the Asian region and the possibilities of their control, In : Proc. IUFRO Regional Workshop on Pests and diseases of forest plantations, 5 - 11 June 1988, Bangkok, Thailand.

Abstract

Four species of carpenterworms (Lepidoptera: Cossidae), viz., *Zeuzera coffeae, Z. roricyanea, Xyleutes ceramica* and *Cossus Cadambae* attack trees *(Tectona grandis)* in the Asian region. A short review is made on their distribution, habits, biology and control.

Mathew, G. and Mohamed Ali, M. I. 1987 Microbial pathogens causing mortality in the Carpenterworm, *Cossus Cadambae* Moore (Lepidoptera, Cossidae) a pest of teak in Kerala. Journal of Tropical Forestry 3: 349-351.

Abstract

In Kerala, 6 species of pathogenic organisms viz. *Aspergillus flavus. Paecilomyces fumosorosens, Penicillium citrimum, Fusarium solani, Serratia marcesceus* and *Pseudomonas* sp. are reported to cause mortality to *Cossus cadambae* (Lepidoptera, Cossidae) a borer pest of live teak trees. This is the first report of micro-organisms causing mortality in this insect.

Mohandas, K., George Mathew, Nair, K.S.S. and Menon, A. R. R. 1988. Pest incidence in natural forests - a study in moist deciduous and evergreen forest of India. In: Proc. IUFRO Regional Workshop on pests and diseases of forest plantations, 5-11 June 1988, Bangkok, Thailand.

Abstract

Insect damage on trees was studied in representative natural forests in Kerala, India. Observations were made on 20 tree species in the moist deciduous forest (MDF) and 18 tree species in the evergreen forest (EGF).

Although most trees had some insect associates causing occasional damage, no major attack was observed during the 2-year study period. Leaf feeding was the most common damage and it was noticed on all tree species to varying degrees. However, except in 8 of the 38 species studied, defoliation never exceeded 10% of the total foliage present to any particular time. These exceptions were *Grewia tiliaefolia, Haldina cordifolia, Lannea coromandelica* and *Tectona grandis* in the MDF and *Anacolosa densiflora, Actinodaphne madraspatana, Cinnamomum verum* and *Litsea floribunda* in the EGF, but even for them the highest mean leaf loss at any particular time was only 21%. Other types of damage, viz., sap-sucking, gall formation and stem boring were insignificant, except in *Mesua nagassarium* in the EGF where some trees were killed by a stem-boring buprestid beetle.

The practical significance of the findings is discussed. Although the study indicates the high-risk species for elimination from plantation trials there is no guarantee that species that are at low risk in in nattral forests will be safe from pests in plantations.

Nair, K. S. S. 1988. An action plan for assessing tropical forest pest problems and establishing priorities for research. In : Proc. IUFRO Regional Workshop on pests and diseases of forest plantations, 5 - 11 June 1988, Bangkok, Thailand.

Abstract

The main constraint to successful control of forest insects in the tropics is economic backwardness, which in turn have led to other constraints. Accepting this reality, attempts must be made to limit the efforts to the most pressing problems and solving them rather than spreading the efforts too thin on many problems. An action plan is proposed which envisages collection of relevant information from each country through the efforts of W P (S 2.07.07) Scientists, co-ordinated by the respective Co-chairmen for each of the tree regions, collation of this information, identification of multinational priority areas and encouragement of networking within the tropics.

Nair, K. S. S. 1988. The teak defoliator in Kerala, India pp. 267 - 289. In : (A. A. Berryman, ed.) *Forest Insects*, Plenum, New York.

Sankaran, K. V. and Sharma, J. K. 1987. Three new hosts of pink disease caused by *Corticium salmonicolor* in Kerala. Indian Journal of Forestry. 10 : 198 - 199.

Abstract

Three new hosts, *Pterocarpus santalinus, Terminalia catappa* and *Cupressus* sp. of *Corticium salmonicolor* have been reported from Kerala.

Sharma, J. K. and Sankaran, K. V. 1988. Incidence and severity of *Botryodiplodia* die-back in plantations of *Albizia falcataria* in Kerala, India. Forest Ecology and Management 24: 43-58.

Abstract

Botryodiplodia die-back of *Albizia falcataria* caused by *Botryodiplodia theobromae* is characterised by the development of a stem canker, gradual die-back of shoots and finally, death of trees due to girdling of stem by progressing cankers. In pathogenicity tests of the isolate, only wound inoculation resulted in cankers similar to those observed in the field. Of the five plantations surveyed, die-back was recorded in four; the occurrence appeared to be closely associated with fire, debarking by animals, and cultivation of tapioca *(Manihot utilissima)* amongst trees in plantations. During the 2 years observation, the initial incidence of about 50% declined to 13-25% while the severity, initially medium, then remained low throughout. Regular observations in a plot with moderately severe infection indicated that the high incidence of die-back occurred during the dry-warm period but during or just after the monsoon it declined as some of the affected trees recouped partially or completely with the overall incidence gradually declining from 94.3%

in June 1983 to 69.8% in May 1985. However, the percentage of mortality of the affected trees increased from 8.3% to 30.3% during the same period. This is the first record of large-scale mortality of *A. falcataria* due to parasitism by *B. theobromae*. The paper discusses the management implications of Botyodiplodia die-back in *Albizia* plantations in Kerala.

Sharma, J. K. and Sankaran, K V. 1988. Biocontrol of rust and leaf spot diseases. pp. 1-23. In: K. G. Mukerji and K. L. Garg (eds.). Biocontrol of Plant Diseases, Vol. II. CRC Press Inc., Boca Raton, Florida, U. S. A.

Sharma, J. K., Maria Florence, E. J., Sankaran, K. V. and Mohanan, C. 1988. Differential phytotoxic response of cut shoots of eucalypts to culture filtrates of pink disease fungus, *Corticium salmonicolor*. Forest Ecology and Management 24:97-111.

Abstract

Relative susceptibility of 23 *Eucalyptus* provenances of 11 species to pink disease caused by *Corticium salmonicolor* was assessed in culture filtrates of two isolates (CS1 from *E. tereticornis* and CS2 from *E. grandis*) of the pathogen, employing cut - shoot bioassay. The results showed statistically significant variation in response among different provenances within a species . Cut-shoots of eucalypts giving susceptible response were affected significantly by the culture filtrates at low dilutions, whereas those giving resistance response tolerated high concentration with little damage to shoots. This evidence clearly indicated an interaction between the host and culture filtrates of the pathogen. The response of CS1 and CS2 culture filtrates gave statistically significant differences in their reactions on various eucalypts, possibly indicating that the isolates are of two different strains. The criticism of cut-shoot bioassay and its significance in laboratory screening of eucalypts to pink disease are discussed.

Sankaran, K. V., Maria Florence E. J. and Sharma J. K., 1988. Foliar diseases of some forest trees in Kerala-new records. Indian Journal of Forestry 11: 11: 104-107.

Abstract

Azadirachta indica and *Terminalia bellerica* are reported as new hosts for *Colletotrichum* state of *Glomerella cingulata*, *Bombax ceiba* and *Xylia xylocarpa* for *G. cingulata*, and *Pterocarpus indicus* for *Cylindrocladium quinqueseptatum* from Kerala, India.

Sudheendra Kumar, V. V., Mohammed Ali, M I. and Mohanadas, K. 1988. Studies on bacterial pathogens associated with the teak defoliator, *Hyblaea puera* Cramer. In: Proc. IUFRO Regional Workshop on pests and diseases of forest plantations, 5-11 June 1988, Bangkok, Thailand.

Abstract

In order to study the occurrence of insect pathogens associated with the teak defoliator, *Hyblaea puera* Cramer (Lepidoptera, Hyblaeidae) a survey was conducted during 1983-1985 in Nilambur and Trichur Forest Divisions of Kerala. Based on this study, two bacterial pathogens namely *Bacillus thuringiensis* and *Enterobacter aerogenes* infecting field population of *H. puera* are reported. In the laboratory culture of the pest, infection by two bacteria, viz. *Serratia marcescens* and *Pseudomonas aeruginosa* was observed. All these four bacteria were isolated in pure culture and pathogenicity confirmed in artificial inoculation trials. Preliminary laboratory studies indicated that *B. thuringiensis* is the most effective bacterium in causing mortality of the larvae of *H. puera*. Potential of these organisms in biological control of *H. puera* is discussed.

Research Reports

Muhammed, E., Chacko, K. C., Sasidharan, N. and Thomas, P. T. Thomas 1988. Study of afforestation techniques in grasslands of Kerala. KFRI Research Report No. 52. Final Report of the project Silvi 02/1972-1982.

Abstract

Grasslands in the high ranges of Western Ghats are considered difficult to afforest with species of our choice. Field trials were conducted during 1977-82 to identify suitable species that could be planted on a large scale. In all, 14 species were tried and their performance judged on the basis of survival and height growth during the initial two years. *Casuarina equisetifolia*, *Eucalyptus grandis*, *E. tereticornis* (using stump as planting material) and *Grevillea robusta* were found to be promising. Large scale trials are needed to assess their long term performance.

Sankar, S., Mary, M. V. and Alexander, T. G. 1988. Foliar analysis in *Eucalyptus tereticornis* and *E. grandis* to assess soil test methods for nitrogen, phosphorus and potassium. KFRI Research Report No. 53. Final Report of the project Soils 08/1982-1985.

Abstract

While plantations of eucalypts occupy over 35,000 ha in Kerala, no studies have been conducted so far to explore the possibilities of nutrient management for increasing productivity. The present work aims at assessing the foliar nutrient levels of *E. tereticornis* and *E. grandis* especially the concentration of nitrogen, phosphorus and potassium in relation to the content of these elements in the soil.

Fieid work was carried out in Kondazhi (1977, *E. tereticornis* plantation, Trichur Forest Division) and Muthanga (1980, *E. grandis* plantation, Kozhikode Forest Division). Soils were collected from pits (0-20, 20-40 and 40-60 cm layers) and the foliar material was sampled thrice (April 1983, September 1983 and March 1984). Analysis of N, P and K in soil and plant were carried out following standard procedures.

Soils in both *E. tereticornis* and *E. grandis* plantations contained low levels of NO_3-N and extractable P while the content of K was moderately high. The same trend was observed in foliar concentrations of these elements. Sampling season did not have an impact on foliar levels of N P. and K and fully expanded leaves were found to be reliable material for foliar analysis. The markedly low concentrations of N and P in the soil as well as plant material suggest that productivity can be improved by soil nutrient management.

Easa, P. S. 1988. Movement pattern of asiatic elephant *Elephas maximus* in Parambikulam Wildlife Sanctuary, Kerala. KFRI Research Report No. 54. Final Report of the project Wild 06/1984-1987.

Abstract

The elephant population in the country has been adversely affected by the loss and fragmentation of of the habitat. Not much information is available on the movement pattern and the home range of Asian elephants. The present study looked into the movement pattern of Asian elephants in Parambikulam Wildlife Sanctuary, Kerala. Two groups of elephants were followed and their routes plotted on an area map. Qualitative assessment of the food and water availability in different parts of the area were also made.

The food availability in the area was nearly uniform throughout the year. The availability of water during dry season was limited to the reservoirs and perennial streams. The dry season movement of the first group was confined to the areas around the reservoirs of Peruvarippallam and Thunacadavu. The movement was extended to the adjacent areas of Anamalai Wildlife Sanctuary of Tamil Nadu during the wet season. Water availability in the area was found to influence the movement pattern of the groups.

The seasonal and annual home range of the groups were computed with a micro-computer programme McPAAL, using Minimum Convex Polygon Method. The dry season minimum home range size of the first group was found to be less compared to that of the second group. The wet season home range size of the first group was comparatively

greater. The annual home range sizes were 124.3 Km^2 and 156 Km^2 for the first and second group respectively. The difference in home range sizes is attributed to the difference in the habitats traversed by the groups. The seasonal and annual rate of mobility of the groups were computed and found to differ significantly. The rate of mobility was higher in primary forests. The results are compared with that of the findings in other areas and the significance is discussed.

Ramachandran, K. K. 1988 Ecology and behaviour of Malabar Giant Squirrel, *Ratufa indica maxima*. KFRI Research Report No. 55. Final Report of the Research Project Wild 04/1983-1985.

Abstract

The Malabar giant squirrel is one of the seven races of Indian squirrels. Four species of giant squirrels belonging to the genus *Ratufa* in the sub family sciuridae are found in oriental region. The status and distribution of the giant squirrels are reviewed. The ecology and behaviour of Malabar giant squirrel, *Ratufa indica maxima* was investigated for a period of two years during January 1983 to June 1985 at Parambikulam wildlife Sanctuary, Palghat, Kerala. The method of investigation was direct observation of the squirrels in the field and recording data by complete record method.

Malabar giant squirrel, *Ratufa indica maxima* is a solitary, diurnal tree squirrel found in the wooded regions of the southern Western Ghats. These squirrels range in distribution from 300 m to 1500 m altitude. Malabar giant squirrels are primarily nucivorous (seed predators), they feed on flowers, leaves and bark when the seeds are scarce. The home range of Malabar giant squirrel was about 13.38 ha in the moist deciduous forest in the study area. The home ranges are overlapping. They make several globular dreys in the canopy with leaves and twigs.

The animals are solitary in nature but they are not territorial and the males came in association with the female during the breeding season between October to November. Malabar giant squirrels give birth to one young in the month of December-January in one of the dreys in its home range. The male giant squirrels did not have any role in the parental care of the young one. The young one began to follow the mother three months after birth. Three generations of a known female giant squirrel was followed. The main interactions seen between the squirrels are mother-young relationship during the preweaning period. This study in Parambikulam Wildlife Sanctuary indicated that birds of prey like crested serpent eagle and black eagle are the main predators of Malabar giant squirrel.

Vijayakumaran Nair, P. and Jayson, E. A. 1988. Habitat utilization by large mammals in teak plantations and natural forests. KFRI Research Report No. 56. Final Report of the Project Wild 05/1983-1985.

Abstract

This study was conducted at the Parambikulam Wildlife Sanctuary, Kerala, to examine the food availability, abundance of animals and damage to teak plantations by wild animals in comparison with adjoining natural forest.

Brachiaria remota, *Mimosa pudica* and *Cyperus* sp. constituted the majority of forbs and were available in many plantations. In contrast to this, younger plantations had more of herbs like *Stictocardia tiliaefolia*, *Cassiatora* and *Acacia* sp. while older plantations and natural forests had more of plants like *Helicteres isora* and *Xeromphis spinosa*. Younger plantations had more of herbs. Herbs preferred by animals were present in all the plantations. The weed *Chromolena odorata* was found in all plantations, the least was in 62-year-old plantation and natural forest. The total number of plant species found in the natural forest and plantations were more or less similar.

Animals like gaur, elephant, deer, wild pig and rodents were found in all plantations. Maximum abundance of animals was in the three-year-old plantation. Gaur was seen in more numbers in one year-old-plantation. Deers were present in good numbers in all the areas. Wild pigs and rodents were more in natural forest. Birds were observed more in natural forest and 62-year-old plantation.

The damage to the one-year-old plantation could not be assessed because most of the plants dried up in summer. In the three-year-old plantation, as many as 425 plants were damaged per hectare. Different animals showed different degrees of affinity to the various plantations. Since the different plantations and natural forests occur side by side, animals could easily move from one habitat to another. The study showed that wild animals use teak plantations and natural forest extensively. However, damage caused to plantations by animals in the study area was not extensive.

Seminar, Symposia, Workshop.....

International

Shri Mamman Chundamannil, Division of Management, attended the IUFRO Forestry Workshop at the Australian National University, Canbera during 12 - 18 May 1988 and presented a paper - "Forest land use policy and the conservation intent in Kerala, India."

Dr. R. Gnanaharan, Division of Wood Science, attended the IUFRO All Division Conference held at Sao Paulo, Brazil during 15-20 May 1988 and presented a paper entitled "Utilization potential of root wilt diseased coconut palms" - by R. Gnanaharan and T. K. Dhamodaran.

Dr. K. S. S. Nair, Division of Entomology, attended the FAO / IUFRO Regional Workshop on Pests and Diseases of Forest Plantations from — 5 - 11 June 1988 at Bangkok. He chaired a session on Pests of Fast Growing Tree Species and presented four papers "An action plan for assessing tropical forest pest problems and establishing priorities for research" - by K. S. S. Nair; "Cossid Pests of teak in the Asian region and the possibilities of their control" by Mathew, G; "Pest incidence in natural Forests — a study in moist deciduous and Evergreen Forest of India", by Mohanadas, K. Mathew, G; Nair, K. S. S. and Menon, A. R. R. and "Studies on bacterial Pathogens associated with the teak defoliator, *Hyblaea Puera* Cramer" by Sudheendra kumar, V. V. Mohamed Ali, M. I and Mohanadas K.

National

Dr. K. S. S. Nair attended a National Workshop on Management in Science and Technology from 18 - 25 April 1988 at Trivandrum, which was organised by the State Committee on Science, Technology and Environment and the Institute for Management in Government.

Dr. K. S. S. Nair has been elected as Chairman of the IUFRO Working Group-S2.07.07 Protection of Forest in the Tropics, with effect from June 1988. Dr. Nair was Co-chairman of this Working Group for the Asia-Pacific Region from August 1986 and now replaces Dr. Heinrich Schmutzenhofer of Austria who has taken over as IUFRO-Secretary from January 1988.

Forthcoming Events

20-22 December 1988. National Seminar on Advances in Economic Zoology, Jodhpur, Rajasthan.

Contact: Dr. S. H. Mohnot, Organising Secretary, Dept. of Zoology, Jodhpur University, Jodhpur 342 001.

20-25 February 1989. International Conference on biodeterioration of cultural property, Lucknow, India.

Contact: Convener, Organising Committee, International Conference on Biodeterioration of cultural property, National Research Laboratory for conservation of cultural property, Sector E/3, Aliganj Schemes, Lucknow 226 020, India.

27-30 March 1989. International Symposium on Biological Control, Riverside, California.

Control : Dr. R. F. Luck, University of California, Riverside, CA92521, USA.

3-7 April 1989. IUFRO working party meeting on Management and Harvesting of Forest Plantations of Multipurpose tree species, Antigua, Gautimala. Contact : Mr. R. Salazar, CATIE 7170, Turrialba, Costa Rica.

11-14 April 1989. IUFRO working party meeting on Data Capture, Collection and Processing, Gemblouse, Belgium.

Contact : P. Adlard, Oxford Forestry Institute, South Parks Rd., Oxford OX13RB, U. K.

11-16 April, 1989. IUFRO project group meeting on New Approaches to Heavy Thinning Regimes. Rotorua, New Zealand.

Contact : Ryde James, Mintstry of Forestry, Private Bag, Rotorua, New Zealand.

31 July - 5 August 1989. Second International Conference on Tropical Entomology, Nairobi, Kenya. Contact : Dr. M. F. B. Chaudhury, Secretary General ICIPE, P. O. Box 30772, Nairobi, Kenya.

28 August - 3 September 1989. IUFRO Conference on Rehabilitation of the Ecosystem of Degraded Forests, Chania, Greece.

Contact : Mr. G. Lyrintzis, Mediterranean Agronomic Institute of Chania, Meditarranean Forestry Department, P. O. Box 85 GR-73100 Chania, Greece.

18-29 September 1989. XIII Commonwealth Forestry Conference, Rotorua, New Zealand.

Contact : XIII Commonwealth Forestry Conference, F. C., 231 Cortorphine Road, Edinburgh EH 12 7AT, Scotland.

24-30 September 1989. IUFRO 56.05.00 Conference on Remote Survey, Venice, Italy.

Contact : H. F. Kaiser, USDA Forest Service, P. O. Box 96090, Washington D. C. 20090 - 6090, USA.

1-18 August, 1990. XIX th IUFRO World Congress, Montreal, Canada.

Contact : Dr. David K. Lemkay, Secretary, Oranising Committee, XIX IUFRO Congress, Box 1990 Montreal, Canada.

23-30 August, 1990. 5th International Congress of Ecology, Yokohama City, Japan.

Contact : Dr. A. Miyawakn, Institute of Environmental Science & Technology, Yokohama National University, 156 / Tokiwadai, Hadogayaku, Yokohama 240, Japan.

28 August-3 Sept. 1990. 4th International Mycology Congress, Regensburg, R. R. G.

Contact: Dr. A. Bresinsky, Institute fur Botanik Univ., Regensburg, Universitat Strasse 31, Post Falch 3108, 8400 Regensbury, F. R. G.

Campus News

Dr. A. R. R. Menon, Scientist, Division of Ecology successfully completed the P. G. Diploma Course in Remote Sensing of Forestry at IIRS., Dehra Dun and returned to the Institute in May 1988

Shri E. A. Jayson, Scientist, Division of Wildlife Biology returned to the Institute in May 1988, after successful completion of training course in Wildlife at the Wildlife Institute, Dehra Dun.

Joined KFRI Recently

Shri P. Aravindakshan — Dy Registrar (Finance)

Left KFRI

Shri Mathew P. Koshy — Scientist, Division of Genetics

Visitors

Dr. James M. Sweeney
Bilatoral Program Co-ordinator
Forest Service, USDA
Washington DC 4-4-1988

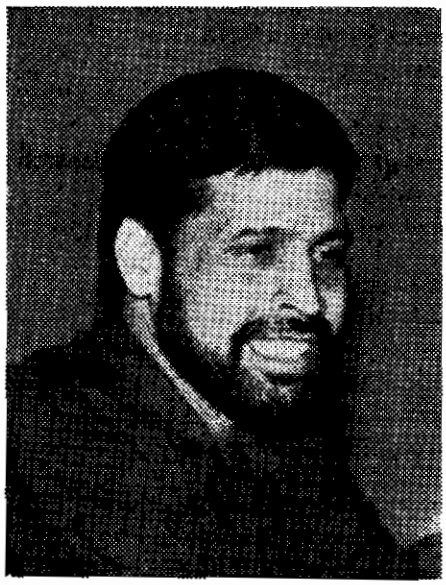
Dr. Eldon W. Ross
Associate Deputy Chief for Research
Forest Service. USDA
Washington DC 4-4-1988

Dr. Charles B. Daney
Professor of Forestry
Soil Science & Plant Pathology
School of Forest Resources
North Carolina State University
Raleigh, North Carolina 4-4-1988

Mr. Peter Hazzlewood
World Resources Institute 13-4-1988

Dr. S. Chinnamani
Asst. Director General (Agroforestry)
ICAR
New Delhi 6-6-1988

Dr. J. P. Pascal
Acting Director
French Institute
Pondicherry 3-9-1988



Dr. C. T. S. Nair leaves KFRI

Dr. C. T. S. Nair, Director, KFRI left the Institute on 7 May 1988 to join the Ministry of Environment and Forests, Government of India, New Delhi as Deputy Inspector General of Forests (Research and Training).

Dr. Nair took his AIFC and joined the Indian Forest Service in 1969. He worked as Divisional Forest Officer at Palghat and Trichur. In 1975 he took M. Phil in Applied Economics from the Jawaharlal Nehru University. From October 1976 to September 1978 he was on deputation to KFRI and served as Forest Economist. In October 1978 Dr. Nair went on study leave from the forest department and did his Ph. D. in Forest Economics at the University of Wales, Bangor, U. K. On his return in Nov. 1981, he joined KFRI as Forest Economist. From April 1986 to May 1988 Dr. Nair served as Director of KFRI. During this period he was able to get a number of sponsored projects to the Institute from both national and international agencies.

Dr. Nair also served as an expert member in many committees such as working group on forest and wildlife constituted by Planning Commission to prepare the Eighth Five Year Plan and steering group on Environment, Forest and Wasteland development under the Planning Commission. He has published about 30 research papers / reports on forest economics and related topics, including a few FAO assignments : (1) Intensive multiple use of forest management in Kerala. (2) A guideline for land evaluation for District level forestry planning and (3) Rural institutions for development of appropriate forestry enterprises. Currently he is in the editorial board of the International journal on Forest Ecology and Management.

We wish Dr. C. T. S. Nair all the best in his future career and look forward to his continued support to our Institute.

Dr. K. S. S. Nair, Scientist - in - Charge, Division of Entomology, took over as Director (In - Charge).

Recent KFRI Publications

Research Reports

No. 50 Surendran, T. and Seethalakshmi, K. K. 1987. Vegetative propagation of some important tree species by rooting cuttings. Final report of research project Physiol 01/79.

No. 51 Nair, K. S. S. and George Mathew. 1988. Biology and control of insect pests of fast growing hardwood species Final report of research project Entom 05/77.

No. 52 Mohammed, E , Chacko, K. C., Sasidharan, N. and Thomas P. Thomas 1988. Study of afforestation techniques in grasslands of Kerala. Final report of research project Silvi 02/77.

No. 53 Sankar, S., Mary, M. V. and Alexander, T. G. 1988. Foliar analysis in *Eucalyptus tereticornis* and *E. grandis* to assess soil test methods for Nitrogen, phosphorous and potassium. Final report of research project Soils 08/32.

No. 54 Easa, P. S. 1988. Movement pattern of Asiatic Elephant, *Elephas maximus* in Parambikulam Wildlife Sanctuary, Kerala. Final report of research project Wild 06/84.

No. 55 Ramachandran, K. K. 1988. Ecology and behaviour of Malabar Giant Squirrel, *Ratufa indica maxima*. Final report of the research project Wild 04/83.

No. 56 Nair, P. V. and Jayson, E. A. 1988. Habitat utilization by large mammals in teak plantations and natural forests. Final report of research project Wild 05/83.