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The Editor, Evergreen
Kerala Forest Research Institute,
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Cover - Evergreen Forest, Nelliampathy

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**Editor's Column**

# Need for a Better Vegetational Classification

Forests play a significant role in the economical and ecological wellbeing of a country. As per the legal definition the extent of forests in India is about 75 million hectares, but the actual area under forest cover is however far less. There is a clear need for much greater quantitative and qualitative information on forest resources to formulate strategies for their conservation and management. In this context forest vegetation classification is more than an intellectual exercise. It is a convenient means for understanding the characteristics of forests and the information has practical application in the fields of ecology and management.

The vegetation of an area can be classified by various methods. One such is 'physiognomic' which is related to the external appearance of the vegetation. Since height and cover of the vegetation are some of the expressions in physiognomy, this type of classification takes care of biomass also. Classifications based on 'life forms' 'floristics' 'vegetational profiles' etc., are also in vogue. In all these classifications, environmental factors are involved and the plant communities form an index of the environment and *vice versa*.

As far as the vegetation of Indian Sub Continent is concerned the most widely accepted system of classification, is the one proposed by Champion in 1936 which was subsequently revised by Champion and Seth in 1968. This system of classification was based mainly on temperature and rainfall although in some known cases humidity, wind etc. were also considered. Based on these, the vegetation of India was broadly classified into four major groups viz., tropical, subtropical, temperate and alpine. They also divided the tropical forests into northern and southern with a series of successive drier types, such as evergreen forest, deciduous forest, savanna, thorn forest, steppe etc

While this system of classification continues to be freely used for nearly five decades it is worthwhile to examine some of its demerits.

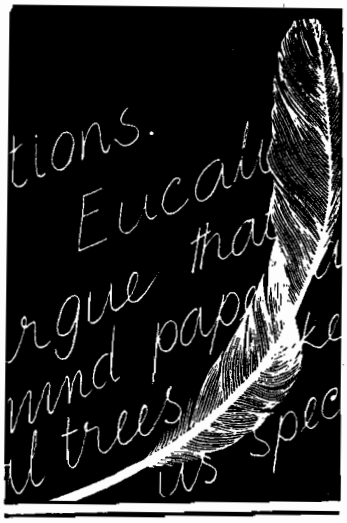
The most serious drawback in this system of classification is that it is based on a few examples selected from the best of the forest stands. For a country like India, an intensive survey is necessary to account for the entire plant cover and a few samples are just not adequate.

Secondly, this classification has incorporated almost all aspects of environment and assorted terminologies pertaining to geography, latitude, temperature, topography, soils, etc. have been freely used to designate a vegetation type. Some of the terminologies like Southern Montane Wet Temperate Forest Southern Tropical Dry Evergreen Forest etc. have been seriously questioned.

Thirdly the title 'wet' accompanying the evergreen forests of northern Kerala and Karnataka can be argued on the ground that these areas certainly experience a dry season lasting for three to four or sometimes even five months unlike parts of Southeast Asia, Africa and South America which bear the 'rain forests'.

Fourthly, the latitudinal notion can also be contested. In the dry deciduous forests, the northern and southern types refer to sal forest and teak forest respectively, the former in general having a more northernly distribution than the latter. However, there are places where teak extends into the latitude of sal (as in some parts of Madhya Pradesh). On the other hand, in places like Vishakapatnam in Andhra Pradesh and Bastar District in Madhya Pradesh sal descends to the teak belt. Thus the latitudinal concept of northern and southern variants is not the true indicator in the distribution pattern.

Finally, the term 'semievergreen' is confusing as it is applied both at the species level (eg. sal or a



OPINION PAGE

Sri. K. K. Nair, IFS (Rtd) comments on the note on 'Leucaena in Kerala' by Sri. K. C. Chacko which appeared in the September 1985 issue of "Evergreen".

"I have seen *Leucaena* as a very effective cover crop in Indonesia. In the teak plantations, in between two rows of teak, *Leucaena* is grown as a continuous line and coppiced. I wonder how this was raised in WEP/25/1935 in Wynad! Was it sown in patches or in lines? It will be interesting to know further details. Moreover, between April planting of eak and sowing of seeds of *Leucaena* in June, the weeds get ahead a lot and will certainly suppress *Leucaena* - If the seeds can be sown in April at the same time or immediately after planting teak (and if it survives the dry period till June) it might be effective. Of course where animal factor is to be reckoned with *Leucaena* will certainly be browsed. Further experimenrs may be worthwhile since tapioca taungya in teak (or anywhere) is a menace resulting in serious soil erosion losing quite a lot of valuable top soil for ever".

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mango tree having a very short spell of defoliation) and also of the vegetation (a mixture of deciduous and evergreen species). Of late, the term semievergreen is used at the level of species and semideciduous for the forests in between the deciduous and evergreen types.

Despite all the above mentioned drawbacks Champion's classification is still followed and publications in recent years continue to use ecological terms like *moist* evergreen forest, *dry* deciduous forest, periodic *swamp* forest etc., laying emphasis on habitat features in labelling the physiognomy. But a vegetation has to be named by its own characteristics and not by the surrounding factors.

In this context it is worthwhile to consider the holistic system of vegetation classification developed by Prof. Gaussen in which he introduced the notion of 'series of vegetation'.

A 'series' includes the various physiognomic stages ranging from the forest to the scattered shrubs encountered in an ecological region. The stages like scattered shrubs, low discontinuous thicket, tall dense thicket, scrub-woodland, open forest and dense forest seem to derive from each other. But if degraded areas are given protection then a return to the forest stage is to be expected in a century or two. Thus the notion of series or vegetation takes into account the succession within an ecological region determined by precipitation, its seasonality, length of dry season, mean temperature of the coldest month and soil factors. The final stage of the series, the maximum encountered in an ecological region is termed as "plesioclimax". It may be a tall evergreen forest in a humid region or only a discontinuous thorny thicket in a desert. A series is named after three or more important species of its plesioclimax stage. These species are selected because of their dominance, abundance, fidelity or economic value. The series also takes into consideration the essential floristic composition.

Based on this system of classification the vegetation of peninsular India has been grouped under 30 series, avoiding some of the complicated terminologies appearing in the classification of Champion and Seth. This system is universally accepted and efforts should be made to use it extensively. □

**Divisional highlights: 7**

# Plant Pathology

Diseases are one of the major constraints in achieving expected yield from forest plantations in the humid tropics. They affect wood production both quantitatively and qualitatively. Unlike in agricultural crops disease control in long rotation tree crops provides serious challenges. The Division of Plant Pathology is geared up to tackle disease problems at plantation and nursery levels. Efforts are directed towards developing ecologically sound remedial measures to reduce the economic losses due to diseases. Research activities undertaken in the Division during the past eight years are highlighted below.

A thorough knowledge on the occurrence of various diseases in forest plantations is essential before attempting to manage them. With this in view, a detailed survey in nurseries and plantations of *Ailanthus triphysa, Albizia falcataria, Bombax ceiba, Dalbergia latifolia, Gmelina arborea, Eucalyptus* spp., *Ochroma pyramidale* and *Tectona grandis* was undertaken and a checklist of diseases with the level of infection of serious pathogens prepared. Of the 90 pathogens recorded, 61 are new host records and 31 recorded for the first time from India, including seven new species i. e., *Pseudoepicoccum tectonae* and *Phomopsis variosporum* on *T. grandis; Meliola ailanthii* on *A. triphysa; Griphospharia gmelinae* on *G. arborea; Physalospora dalbergiae* on *D. latifolia* and *Cytospora eucalyptii* and *Valsa eucalypticola* on *Eucalyptus.* Potentially serious diseases which cause large scale mortality or damage in nurseries and plantations have been identified. Cryphonectria stem canker of eucalypts (Fig. 1) earlier reported from Brazil, Cuba, Hawaii and Surinam has been recorded to cause upto 3% mortality in *E. grandis* plantations in Wynad plateau; the incidence of the disease varies greatly from 0 to *ca.* 30% depending upon the species of *Eucalyptus* and climatic conditions.

*Cylindrocladium,* which causes a disease complex in eucalypt seedlings and leaf blight in plantations, is the major pathogen affecting the nursery stocking, early establishment of outplanted seedlings and young coppice shoots. A survey revealed a total of nine species of the fungus *Cylindrocladium.* associated with various diseases. *C. curvatum, C. theae, C. floridanum* and *C. clavatum* have been recorded for the first time from India. Of the nine species, *C. ilicicola* and *C. theae* are localised in high ranges where *E. grandis* is grown, while the others are distributed throughout Kerala. The important species which cause large-scale mortality of seedlings and extensive leaf blight in plantations are *C. quinqueseptatum, C. theae, C. clavatum* and *C. ilicicola.* Factors affecting the incidence and spread of the disease in plantations, host-pathogen relationships, relative susceptibility of eucalypt provenances

Fig. 1. Stem canker of *Eucalyptus grandis* caused by *Cryphonectria cubensis.*

and genetic variability in *Cylindrocladium* have been studied in detail.

In high rainfall areas of the State eucalypt seedlings are affected severely by various fungal pathogens including *Cylindrocladium* at the nursery stage. Large-scale mortality/damage of seedlings caused by these diseases seriously affects the plantation programme by reducing the seedling stock, A package of practices have been standardized for raising disease-free, healthy eucalypt seedling in nurseries. Chemical control measures of 20 seedling diseases in all the tree species have been worked out and field tested.

Pink disease caused by *Corticium salmonicolor* is the most serious disease of eucalypt plantation, affecting the yield considerably. Since chemical control of this disease is not economically feasible, raising plantations with disease resistant species/ provenances is the most suitable proposition. For screening eucalypts resistant to pink disease, a toxin bioassay method has been standardized. The advantage of this method is that even seedlings can be screened for disease resistance Of the 23 provenances of eucalypts tested, a few have shown moderate resistance.

A survey conducted in nursery and plantations of *Albizia falcataria* has revealed the occurrence of only three diseases: web blight of seedlings in the nursery and die back due to stem canker and Phomopsis shoot die-back in plantations. Web blight causes considerable mortality if it appears within a month of emergence of seedlings. Of the several fungicides screened Bavistin (0.01% a. i.) has been found to be very effective in controlling the disease. Die-back and canker, caused by *Botryodiplodia theobromae,* is the most serious disease in plantations throughout the State. Large-scale mortality of trees due to this disease was recorded at Niangchee (Thenmala Forest Division.) and Kollathirumed (Vazhachal Forest Division). Since *B. theobromae* is a wound parasite, the disease can be avoided to a great extent by protecting the plantations from biotic factors, fire and removal of tapioca stem (which forms a good substratum for the pathogen from the plantation after the extraction of tubers. *Phomopsis* shoot die-back is not a serious disease and it occurs only in trees weakened by fire.

*Dendrophthoe falcata* var. *pubescens,* commonly known as loranthus is a very damaging phanerogamic parasite (mistletoe) of teak especially in Northern and Central Circles of Kerala. The parasite infestation is recorded to be upto 85% in some of the teak plantations of Nilambur Forest Division. Generally plantations above the age of seven years are infested by the parasite. Mortality of trees is more in young plantations than in older ones. A study conducted

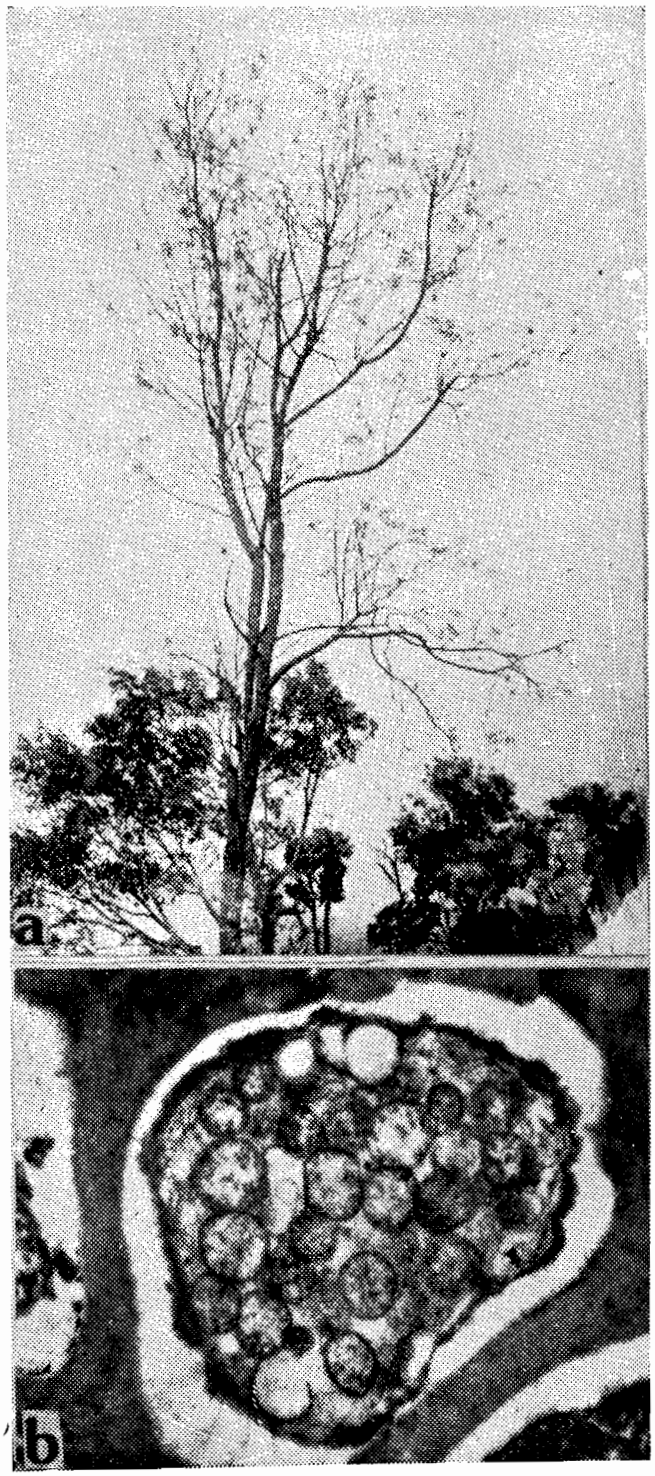


Fig. 2

# Endemic Trees of Western Ghats

## *Gluta travancorica* Bedd.

The only representative of the genus *Gluta* Linn. (ANACARDIACEAE) in the Indian sub continent, *Gluta travancorica* is found restricted to the Evergreen forests of Southern Western Ghats (Travancore and Tinnelveli mountains). A very large tree with blackish grey bark and pale pinkish blaze, it is a better known timber species among the Western Ghat endemics. The glossy dark green leaves crowded at branch tips, measuring up to 15/7 cm are elliptic to obovate with wavy margins and attenuate at base to the dilated petioles. The white flowers collected in subcorymbose panicles are usually 5-meres with one ovuled ovary. The subglobose dry fruits measuring 2-3 cm in diameter are short stalked.

The wood is hard (about 720 kg/m³), close grained, mottled with black and orange streaks and is much valued for furniture and building construction. Locally known as *Thenmavu, Thodappei* and *Shenkurani*, the wood of this species is 'considered to be the one of the finest, and most beautiful timbers in India' (Wealth of India). At present the availability of this very valuable endemic tree with moderate growth is restricted principally near streamsides. The role of this species in catchment protection and enrichment planting is yet to be explored.

**N. G. NAIR**
Division of Botany (Taxonomy)

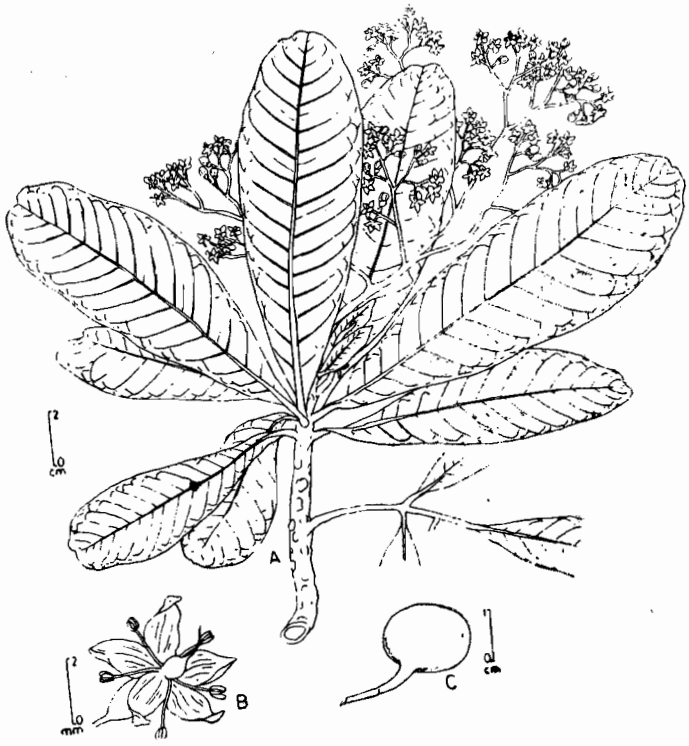


Fig A-Twig, B-Flower, C-Fruit

during 1980-1983 has shown 42.0% loss in a 34-year -old plantation. Physical removal of the parasite by lopping of the infested branches of teak improved the gbh increment by 39.0% and 7.2% respectively in the above young and old plantations. It has also been shown that the mistletoe infestation considerably affects the wood quality.

An efficient and economical technique for infusing chemicals into trees has been developed and utilized in the experiments on the control of the teak parasite. Of the several herbicides screened SENCOR was found to kill the parasite selectively without affecting teak. Feasibility of large-scale application of tree infusion technique for the mistletoe control is under investigation.

Spike disease of sandal caused by mycoplasma-like-organisms which eventually kills the affected trees within 1 to 2 years has been observed in Marayoor Sandal Reserve (Fig. 2). The disease is spreading radially from the initial focal point in Reserve 51. Till now no confirmed vector of this disease was known. *Redarator bimaculatus* has been identified as the insect vector of the spike disease through vector transmission and transmission electron microscopic (TEM) studies Infusion of tetracycline in the spiked trees gives remission upto 7-8 months, after which the disease reappears.

Yet another study revealed that little leaf disease of eucalypts is caused by mycoplasma-like-organisms. Investigations on effect of different rhizobial strains on the root nodulation of *Leucaena leucocephala* showed that few local strains are as good as the best known strains for acid soils, Acidity of soil below pH 5 not only inhibits root nodulation but also root growth.

Since fhe chemical control of insect pests in plantations has limitations due to management problems and pollution hazards, search for the natural enemies has become important. With this in view, studies are in progress on evaluation of microbial pathogens as bio-control agents against important insect pests of *Ailanthus triphysa* and *Tectona grandis*. Some pathogens isolated from the field infected insects have given promising results at the laboratory level. Further investigations are in progress.

Apart from routine project work, extension work relating to disease problems in nurseries and plantations of the Forest Department is also handled by the Division. The Division maintains a reference collection of authentically identified fungal and bacterial cultures and a herbarium of oisease specimens.

← Fig. 2 a. Spike-diseased sandal
b. MLO in sieve cell of a spiked sandal

**Interview**

# Vegetation: Mapping and Influences

Dr. V. M. Meher-Homji, a well known ecologist working at the French Institute, Pondicherry was interviewed in May '86 by *Evergreen*.

*Evergreen*. You have been associated with the French Institute, Pondicherry for nearly three decades. Could you kindly enlighten us on the activities of the Institute?

*Meher-Homji*. We have got two sections in French Institute; one is Indology dealing with research in ancient literature in Tamil and Sanskrit, and the other is the scientific section. The scientific section was set up in 1956 with the main purpose of studying features of the environment like vegetation, climate and soils which permitted the South Indian cultures to flourish. I am associated with the scientific section and one of our principal activities is mapping of vegetation in collaboration with the Forest Departments. This scheme actually started in 1956 with the technical co-operation of Indian Council of Agricultural Research and so far we have been able to bring out twelve sheets of vegetation maps of India starting from extreme south, Kanyakumari upto 28°N. We could not cover the remaining regions because under the Defence of India rules we cannot take up areas near the International boundaries. Now, apart from preparing vegetational maps we have also been studying the bioclimates, attempting to map them at different scales and also carrying out some work on forest soils. In India, soil studies are undertaken mainly in agricultural lands.

THE FRENCH INSTITUTE, PONDICHERRY HAS TWO SECTIONS; INDOLOGY AND SCIENTIFIC. THE SCIENTIFIC SECTION WAS SET UP IN 1956 WITH THE MAIN PURPOSE OF STUDYING FEATURES OF THE ENVIRONMENT LIKE VEGETATION, CLIMATE AND SOILS.

WITH THE TECHNICAL CO-OPERATION OF ICAR WE HAVE BEEN ABLE TO BRING OUT 12 SHEETS OF VEGETATION MAPS OF INDIA FROM KANYAKUMARI IN SOUTH TO 28°N.

Recently we have modernised our soil laboratory with the view of studying in greater detail the forest soils and the relationship between the forest soils and the edaphic factors on one hand and the types of forest on the other. Another field of research at the French Institute is Palynology i. e., the study of pollen grains. Pollen grains are something like our finger prints and by knowing the pollen grains one can see to which species they belong. It has got its application in taxonomy, and also in reconstructing the past history. So, pollen grains have been collected either from lake bottoms or from peaty sediments of mangrove areas or from hill areas like Kodaikanal and Ooty and these together with the soil parts are analysed at an interval of every five centimeters. Any change that has taken place in the vegetation can be deciphered from the study of these pollen grains collected. These are the main points of research at the French Institute.

*Evergreen.* But the thrust item is the vegetation mapping and what is special about the maps prepared by your Institue compared to ones prepared by the Forest Survey, NRSA, Survey of India etc.?

*Meher-Homji.* Good maps have been prepared by NRSA and Forest Survey of India using remote sensing techniques. There the aim is mainly to know the percentage of the forest cover, whereas we show the forest typologies and also various stages of degradation of the forest. Now the first problem that would arise is the very definition of a forest or the definition of a thicket. So we have standardised the nomenclature according to the convention of the Yengamby Conference and every physiognomic landscape has a distinct definition. So when we talk of a thicket we have to define it. A bush would mean to us a low type of vegetation, something like a thicket or a continuous thicket. But to an Australian, bush would mean tall forest of eucalypts. So we have to be sure of our definitions first.

*Evergreen.* Can you elaborate upon how these maps are prepared?

*Meher-Homji.* You know, a good deal of information already exists with the Forest Departments. They have got good Stock Maps, Working Plans and Forest Maps. But when we are studying regions like Southern India we have to refer so many Working Plan maps, stock maps, and so on. So we have tried to bring together all this information on one map. We could prepare this map at 1:1,000,000 scale thanks to the co-operation offered to us by by the Forest Department of different states. Another important point about these maps is the uniformity of the methods. So many types of maps are being produced in the World today. But each map is prepared based on decisive principles and one cannot compare a map of South India with another

SO MANY TYPES OF MAPS ARE BEING PREPARED IN THE WORLD TODAY. BUT EACH MAP IS PREPARED BASED ON DECISIVE PRINCIPLES AND ONE CANNOT COMPARE A MAP OF SOUTH INDIA WITH ANOTHER OF SOUTH AMERICA OR SOUTHEAST ASIA.

of South America or South East Asia. Here we have been following the methods of Professor Gaussen who is acknowledged as the father of vegetation mapping. His main principle is the use of colours on the map to indicate the ecological conditions. I mean, one could give any colour for any type of vegetation, but then colour has to have an ecological or climatic significance. Actually, Professor Gaussen evolved this system of colour when he was a prisoner of of war. During Second World War all the eminent professors of France were taken as prisonors of war by the German invaders. Then Professor Gaussen had with him his data, both vegetational and climatic. He was preparing his doctoral thesis. So, on one hand, he had vegetation map, on the other various climatic data like, rainfall, temperature, insolation and other parameters.

WE HAVE BEEN FOLLOWING THE METHODS OF PROF. GAUSSEN WHO IS ACKNOWLEDGED AS THE FATHER OF VEGETATION MAPPING. HIS MAIN PRINCIPLE IS THE USE OF COLOURS ON THE MAP FOR INDICATING TYPE OF VEGETATION. I MEAN, ONE COULD GIVE ANY COLOUR FOR ANY TYPE OF VEGETATION, BUT THEN COLOUR HAS TO HAVE AN ECOLOGICAL OR CLIMATIC SIGNIFICANCE.

Now he tried to bring about similarity between vegetation map and climatic map. Suppose for temperature factor he gave pink colour, then he found this did not coincide with vegetation map. For example, southern slopes in northern latitudes have more sunlight than the northern slopes. So it adds up to the heat budget. So he added one shade more of pink for the southern slopes and one shade less for the northern slopes. In this manner the similarity was arrived at between the two maps, vegetation and climatic. This was how his system of mapping was evolved. You know that in any atlas or in most of the maps you find green colour indicating forest and any type of forest whether tropical forest, sal forest, teak forest, temperate pine forest, all would be shown in green colour and grasslands having different equality potentials would be shown in yellow colour. So colour would lose significance

YOU KNOW, IN ANY ATLAS, OR MOST OF THE MAPS YOU FIND GREEN COLOUR INDICATING FORESTS, AND ANY TYPE OF FORESTS WHETHER TROPICAL FOREST, SAL FOREST, TEAK FOREST, TEMPERATE PINE FOREST, ALL WOULD BE SHOWN IN GREEN COLOUR..... SO COLOUR WOULD LOOSE ITS SIGNIFICANCE ON THE MAP.

on map. On the other hand, Gaussen used the spectrum: blue colour for rainfall because blue is the colour of all water bodies, red for very low rainfall as in deserts to indicate heat and burning effect and intermediate colours of the spectrum to get the intermediate climatic conditions. Similarly, he selected red colour for high temperature, orange for low and so on. He tried to superimpose the colour of the rainfall class on the colour of the temperature class for example, i.e. for tropical humid regions like Kerala, blue referring to high rainfall would be superimposed on red for high temperatures. The resultant colour would be violet. Now, the moment one sees violet colour on any vegetational map of any country one can immediately conclude that it deals with a particular environment and the potential vegetation will be of evergreen type. This is the principle. Now these colours given by the climatic complex would be used in different manners and different patterns to indicate the physiognomic stage. Let us say, it is an original evergreen forest. It will be shown in violet colour. If the evergreen forest is degraded by man and brought to the stage of an open forest then we will use violet colour but in bands instead of applying violet in full. Grasslands will

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be shown by a network of fine dots in violet colour. So you can make out the degradations of the series and also their potentiality. I mean what will be its potential, whether it will evolve into an evergreen forest, deciduous forest, etc. So this can be brought out by the colours.

*Evergreen*. Could you please explain the preparation of 1:1,000,000 scale map, its data collection, cartographic aspects etc.?

*Meher-Homji*. You see, when we started in 1956 it was a very difficult task to gather data. Now, for a small country like France which has been explored for centuries, gathering information may not be a serious problem, whereas in India in formation may be lacking for hundreds of square kilometers. As it was difficult to get the precise information we had to start with a smaller scale. Then, of course, once this project was over at one million scale, suggestions came from the Forest Departments themselves, to survey in more details which could help the forest management. With this aim in mind we started mapping at the scale of 1:250,000. The project was launched around 1977 and we received good deal of cooperation from the Chief Conservators like Mr. K. K. Nair who very kindly came forward that we should do the mapping of the Kerala State and with his good offices he could officialise the scheme with Government of Kerala. Mr. Shyam Sunder, Chief Conservator of Forest of Karnataka was also very much interested and so was the Government of Tamil Nadu. At the same time there was development in the field of remote sensing. The satellite pictures became available.

THE CHOICE OF SCALE DEPENDS ON THE AMOUNT OF DATA YOU HAVE GOT. TO MAKE A MAP AT THE 1:1,00,000 SCALE, YOU HAVE TO BRING ALL THE BASIC DATA AT THE SCALE OF 1:250,000. THEN YOU REDUCE IT TO 1:1,000,000 BECAUSE BY REDUCTION YOU ADD PRECISION TO YOUR MAP.

These satellite imageries helped us a great deal in bringing out maps in 1:250,000 scale. The choice of scale also depends on the amount of data we have. I mean to bring out a map at the scale of 1:1,000,000 we have to bring all our basic data at the scale of 1:250,000. Then we reduce it to 1,000,000 because by reduction you add precision to your map. Similarly for preparing maps at 1:250,000 scale we worked at the scale 1:50,000 and the map was reduced to 1:250,000. This way we increase the accuracy of the map.

*Evergreen.* There is already a classification existing on forest types, for example, the classification of Champion and Seth. Could you explain further work in this line?

*Meher-Homji.* Now, I should say that the very fact that this classification continues for almost five decades speaks volumes of it. In the first set of maps at 1:1,000,000 we tried to introduce the "series of vegetation" of Professor Gaussen but later we realised that the Forest Officers were not quite familiar with this system and for the latest series of maps of 1:250,000 scale we have come back to Champion's system of classification. Now obviously when you look into the details there are some nomenclatures in Champion's type with which it is difficult to agree. Let me quote the use of tropical dry evergreen forest of the Coromandel and Circar Coast. Here the regime is not typically tropical. It is what we call tropical dissymmetric type with the bulk of rain occurring towards end of the year in October-November and the rainfall curve losing its symmetry as in the case of typical tropical regime. So the regime cannot be called typical tropical. The climate is not so particularly dry in this area and the formation is not evergreen. Dr. Balasubramanyan has shown that in the thicket of Marakanam at least 50 per cent species were deciduous. It would be more apt to call it semievergreen formation and finally it is not a forest in the true sense of the word, but is only a thicket. So like this, we do not completely agree with the classification of Champion and Seth. But all said and done, it is the basic classification which is understood by all the Forest Officers and that is why we also decided that instead of continuing with our classification of series of vegetation, we refer to Champion's classification.

SO LIKE THIS WE DO NOT COMPLETELY AGREE WITH THE CLASSIFICATION OF CHAMPION AND SETH. BUT ALL SAID AND DONE, IT IS THE BASIC CLASSIFICATION UNDERSTOOD BY ALL FOREST OFFICERS.

*Evergreen.* Please comment on the significance of forest conservation?

*Meher-Homji.* Using the most recent satellite imageries we find the forest cover of India to be only about 10%. But Forest Survey of India, in their recent estimate maintains that 19% is under forest cover. We beg to differ from that of NRSA which has given a figure of about 14%. But I think Birla Institute of Jaipur has also come out with a figure of only 11% under forest in India and I think one of the major problems is to preserve whatever remains. We have not fully understood the economic value of the various species. Most of the food items that we consume come only from 20 species out of the 450 thousand species of plants known all over the world. I think we will have to look for other resources in the years to come. Whatever we have been eating; cereals, pulses, etc., are the gifts of our forefathers. Though, through technological progress man has been able to go to moon and what not, there has been very little addition to our diet. It is said that there would be enough foodgrains to eat but there will not be enough fuelwood to cook it. So we have to go for those food items which do not need cooking, like fruits. There should be greater emphasis on fruits. For example, the tribals eat the fruits of *Donella roxburghii*. But outside nobody knows about this. Further, around Pondicherry we have got some-thickets and they contain many useful species.

WE FIND THAT THE FOREST COVER OF INDIA IS ONLY ABOUT 10%. THE FOREST SURVEY OF INDIA MAINTAINS THAT 19% IS UNDER FOREST COVER WHILE NRSA HAS GIVEN A FIGURE OF 14%.

IT IS SAID THAT THERE WOULD BE ENOUGH FOOD TO EAT BUT NOT ENOUGH FIREWOOD TO COOK IT. SO WE HAVE TO GO FOR THOSE FOOD ITEMS WHICH DO NOT NEED COOKING, LIKE FRUITS. WE HAVE GOT MANY DELICIOUS FRUITS LIKE *DONELLA ROXBURGHII, SYZYGIUM* SPP., *GARCINIA* SPP. ETC.

One example is *Ormocarpum sennoides* (in Tamil 'Elumpotti') which is a climber. The leaves are reported to be good in mending fractures by a local bone setting centre at Puttur near Tirupathi. Their treatment is much more efficient by use of these herbs than the treatment received in some hospitals. But unfortunately they do not give out names of the herbs or how they use it. Now we came to know through the natives around the thickets, at Pondicherry that they make use of the leaves of 'Elumpotty'. Unfortunately what is happening is that these thickets are being cleared, and in their place eucalypt is being introduced. We are losing all these without knowing their importance.

*Evergreen.* Could you say something on the debate that is going on about the influence of forests on rainfall?

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WE HAVE OROGRAPHIC RAINFALL DUE TO THE EFFECT OF MOUNTAINS, THEN WE HAVE CONVECTIONAL RAINS, CYCLONES AND DEPRESSIONS. FOREST CANNOT INFLUENCE CYCLONES, BUT FORESTS DO PLAY A CONSIDERABLE ROLE IN CONVECTIONAL RAINFALL.

# Eravikulam National Park

The Eravikulam National Park is located between 76°50' 77°10'E longitude and 10°7' to 10°19' N latitude along the crest of the Western Ghats in Idukki district of Kerala State. The area is flanked in the south by Anai Mudi (2690 m), the highest peak in peninsular India. Part of the northern boundary coincides with the state boundary of Tamil Nadu. The south and east are bordered by tea estates and the western side by the Reserved forest of Munnar division. The closest town is Munnar, lying south of Eravikulam National Park, which is connected to Kottayam (148 km) and Ernakulam (130 km) by road. The nearest road is the one from Munnar to Udumalpet (Tamil Nadu), passing just east of the park. The access to the park is through the tea estates of the Tata Tea Company. A motorbike track is maintained from Vaguvarrai tea estate to the central plateau of the park which is known as Hamilton Plateau. Inside the National Park there is no motorable road. Rajamally, the headquarters of the park is 16 km from Munnar.

## Climate

The climate of Eravikulam plateau, eventhough not typically tropical is often referred to as tropical montane. Due to the effect of altitude, low temperature is prevalent during the winter months. The maximum temperature recorded during 1979 to 1981 in Eravikulam hut area is 29°C in May and minimum -3°C in January. The area receives heavy rainfall, bulk of which is precipitated by south-west monsoon between June and August, and rest in October-November by north-east monsoon. The average rainfall recorded at Vaguvarrai Estate near Eravikulam is 4090 mm for the years 1967-79. Strong wind and mist occur in the rainy season. Eravikulam and adjacent areas are subjected to lesser degree of biotic interference when compared to similar areas like Nilgiri and Palni Hills. The best time to visit Eravikulam National Park is from January to May.

Fig. 1. General view of Eravikulam National Park

## History

A conservation programme implemented by the British tea planters of the Kannan Devan Hill Produce Co. led to the preservation of this unique area which was recently named as Eravikulam National Park. The altitude and climate of the area were not suitable for plantation crops like tea. The company looked after the area, maintained the regulations for sport hunting of game animals and fishing, ably supported by High Range Wildlife Preservation Association and High Range Angling Association formed in 1928 and 1933 respectively. Muduvas, the native tribals there were working as game-watchers and the managers of the adjacent estates were functioning as game wardens of the area.

When the land reforms came into effect in 1971, ownership of all uncultivated land was vested with the Government. The smooth transfer of the area to the Government of Kerala was carried out by Mr. J. C. Gouldbury, the then Chairman of the High Range Wildlife Preservation Association. Subsequently, in 1975 the area was gazetted as a Wildlife Sanctuary and in 1978 it was declared as a National Park comprising 105 km² which includes a unique area of rolling grasshills and shola forests in the mountain folds. In this way the habitat of the largest population of Nilgiri Tahr in the world was protected.

## Forest types and flora

The grassland and shola of Eravikulam are very much similar to that of Nilgiri Plateau. (Fig. 1) Shetty and Vivekananthan (1971) have given details of the flora of Anai Mudi and surrounding regions. Out of the 182 taxa of flowering plants collected from an altitudinal range of 1925 m to 2695 m, 82 were found in the sholas, 6 confined to the fringes of forest along banks of streams and the remaining 94 were restricted to the grasslands. The shola species consisting of herbs, shrubs, climbers and epiphytes constitute 29 species of which 15 are restricted in their distribution to the Western Ghats and adjacent regions. Sholas of Eravikulam abode characteristic trees like *Actinodaphne bourdillonii, Elaeocarpus recurvatus, Ilex denticulata, I. wightiana, Ligustrum perrottetii, Litsea wightiana* var. *tomentosa, Michelia nilagirica, Microtropis ramiflora, Pithecellobium subcoriaceum, Pittosporum tetraspermum, Symplocos pendula* and *Syzygium arnottianum.* The trees are generally stunted, rarely exceeding 6 m in height, with branches and trunk covered by mosses, lichens, orchids, tree ferns and other epiphytes. There are no distinct canopy layers and it is a continuum from undershrubs to shrubs and larger shola trees. In the transition zone between montane woodlands and the typical tropical wet evergreen forests, the tree height ranges from 10 to 15 m. The principal tree species in this area include *Aporusa* sp. *Elaeocarpus oblongus, Eurya nitida, Garcinia cambogia* var. *papilla, Gomphandra coriacea* and *Mastixia arborea.* The undergrowth mainly consists of *Strobilianthus.*

In the grasslands, 94 species were recorded of which 45 are those confined to the montane zone of Southern India. Another 18 species are restricted to Western Ghats and Sri Lanka. There is high incidence of endemics to Anai Mudi and its adjoining areas. *Habenaria flabelliformis, Impatiens anaimudica, I. coeltropis, I. pandata, I. platyadena, Isache fiseheri* and *Sonerila nemakandensis* are the seven such endemics occurring in the regions.

The adverse effect of fire, the physiological drought induced by the frost during winter on the seedling of forest species, are the reasons limiting the distribution of the shola forest. According to Meher Homji (1965) the species which thrive well in the open areas at higher elevation are cold resistant. There is also a possibility that wind and soil moisture might also limit the expansion of sholas.

Muduva colonies are located at elevations of 1200 m and very rarely up to 1800 m. They practice shifting cultivation outside the park area. There is no record of shifting cultivation within the limits of the National Park.

## Fauna

Nilgiri tahr *(Hemitragus hylocrius)* is an endangered species restricted to some pockets in the Western Ghats (Fig. 2). Largest known wild population of it exists in Eravikulam National Park. Based on a survey work of Davidar (1978), Nilgiri tahr is occurring in 18 different areas along the Western Ghats with a total population of 2,200 animals of which about 550 animals are confined to Eravikulam area. In 1983, the tahr population of Eravikulam National Park was 700 (Varghese, 1983). Our knowledge on the behaviour and ecology is restricted to the investigations by Rice (1984). Nilgiri Tahr is mostly restricted to steep cliffy areas and grasslands and do not stay in sholas. They could be seen in herds numbering upto hundred and fifty animals.

THE CHOICE OF SCALE DEPENDS ON THE AMOUNT OF DATA YOU HAVE GOT. TO MAKE A MAP AT THE 1:1,00,000 SCALE, YOU HAVE TO BRING ALL THE BASIC DATA AT THE SCALE OF 1:250,000. THEN YOU REDUCE IT TO 1:1,000,000 BECAUSE BY REDUCTION YOU ADD PRECISION TO YOUR MAP.

These satellite imageries helped us a great deal in bringing out maps in 1:250,000 scale. The choice of scale also depends on the amount of data we have. I mean to bring out a map at the scale of 1:1,000,000 we have to bring all our basic data at the scale of 1:250,000. Then we reduce it to 1,000,000 because by reduction you add precision to your map. Similarly for preparing maps at 1:250,000 scale we worked at the scale 1:50,000 and the map was reduced to 1:250,000. This way we increase the accuracy of the map.

*Evergreen*. There is already a classification existing on forest types, for example, the classification of Champion and Seth. Could you explain further work in this line?

*Meher-Homji*. Now, I should say that the very fact that this classification continues for almost five decades speaks volumes of it. In the first set of maps at 1:1,000,000 we tried to introduce the "series of vegetation" of Professor Gaussen but later we realised that the Forest Officers were not quite familiar with this system and for the latest series of maps of 1:250,000 scale we have come back to Champion's system of classification. Now obviously when you look into the details there are some nomenclatures in Champion's type with which it is difficult to agree. Let me quote the use of tropical dry evergreen forest of the Coromandel and Circar Coast. Here the regime is not typically tropical. It is what we call tropical dissymmetric type with the bulk of rain occurring towards end of the year in October-November and the rainfall curve losing its symmetry as in the case of typical tropical regime. So the regime cannot be called typical tropical. The climate is not so particularly dry in this area and the formation is not evergreen. Dr. Balasubramanyan has shown that in the thicket of Marakanam at least 50 per cent species were deciduous. It would be more apt to call it semievergreen formation and finally it is not a forest in the true sense of the word, but is only a thicket. So like this, we do not completely agree with the classification of Champion and Seth. But all said and done, it is the basic classification which is understood by all the Forest Officers and that is why we also decided that instead of continuing with our classification of series of vegetation, we refer to Champion's classification.

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*Evergreen*. Please comment on the significance of forest conservation?

*Meher-Homji*. Using the most recent satellite imageries we find the forest cover of India to be only about 10%. But Forest Survey of India, in their recent estimate maintains that 19% is under forest cover. We beg to differ from that of NRSA which has given a figure of about 14%. But I think Birla Institute of Jaipur has also come out with a figure of only 11% under forest in India and I think one of the major problems is to preserve whatever remains. We have not fully understood the economic value of the various species. Most of the food items that we consume come only from 20 species out of the 450 thousand species of plants known all over the world. I think we will have to look for other resources in the years to come. Whatever we have been eating; cereals, pulses, etc., are the gifts of our forefathers. Though, through technological progress man has been able to go to moon and what not, there has been very little addition to our diet. It is said that there would be enough foodgrains to eat but there will not be enough fuelwood to cook it. So we have to go for those food items which do not need cooking, like fruits. There should be greater emphasis on fruits. For example, the tribals eat the fruits of *Donella roxburghii*. But outside nobody knows about this. Further, around Pondicherry we have got some-thickets and they contain many useful species.

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Other herbivores present in Eravikulam National Park include sambar *(Cervus unicolor)*, gaur *(Bos gaurus)*, barking deer *(Muntiacus muntijak)* and elephant *(Elephas maximus)*. The carnivores comprise tiger *(Panthera tigris)*, panther, black panther *(Panthera pardus)*, wild dog *(Cuon alpinus)*, jackal *(Canis aureus)* jungle cat *(Felis chaur)* Nilgiri marten *(Martes gwatkinsi)*, stripednecked mongoose *(Herpestes vitticollis)* etc. The arboreal mammals occurring in the sholas are Nilgiri langur *(Presbytis johni)* and giant squirrel *(Ratufa indica)*. Sloth bear *(Melursus ursinus)* is not reported in the Eravikulam Plateau. Trouts thrive well in the streams in the area and there is no report of otter or crocodile from such high altitudes.

## Literature Cited


Davidar, E. R. C. 1978. Distribution and status of the Nilgiri Tahr *(Hemitragus hylocrius)* 1975-78 *J. Bombay nat. Hist.* Soc. 75:815-844.

Meher-Homji, V. M. 1965. Ecological status of the montane grasslands of the South Indian Hills: a phytogeographic reassessment. *Indian For.* 91: 210-215

Rice, C. G. 1984. The behaviour and ecology of Nilgiri Tahr *(Hemitragus hylocrius* Ogilby) Ph. D. Thesis, Texas, A & M University, U. S. A. 254 pp.


Fig. 2. A herd of Nilgiri Tahr

Some typical birds of the area include laughing thrush, black and orange flycatcher, south indian black bulbul, pied bushchat, Malabar crested lark and Nilgiri pipit. Blackwinged kite and kestrel are also seen hovering in the open. Eravikulam National Park area is blessed with inaccessibility especially during rainy season, If properly managed, the park will be a monument of wilderness, a magnificient piece of hill country and an area which in the course of time can transform into an excellent park for those who would like to hike, fish and observe wildlife.


Shetty, B. V. and Vivekananthan, K. 1971. Studies on the vascular flora of Anaimudi and the surrounding regions, Kottayam Dist., Kerala. *Bull Bot. Surv. India* 13:16-42

Varghese, R. 1984. Census of Nilgiri Tahr. Project Report; Department of Mathematics, Union Christian College, Alwaye, 32 pp.



**K. K. RAMACHANDRAN**
Division of Wildlife Biology

# Avenue Trees

Plants with attractive flowers and foliage gained importance since man started domesticating wild plants. They provide comfort both to body and mind. Trees have always been the source of inspiration to the ancient yogis and monks and they performed their prayers and meditation under the canopy of trees.

The practice of planting ornamental trees along roadsides and building premises was primarily meant to enrich the scenic beauty. Besides beautifying the area trees perform a variety of services to man. They absorb carbon dioxide from the atmosphere and release oxygen, filter dust from the air and provide shade. Plants with rough bark surface and tomentose leaves reduce the noise pollution considerably and serve as indicators of toxic chemicals in the atmosphere. When pollutants like sulphur dioxide and hydrogen fluoride reach critical level in the atmosphere, plants get injuredand exhibit characteristic symptoms.

The selection and arrangement of plants is a crucial step in the ultimate success of avenue planting. It should be borne in mind that usually avenue trees are planted in an environment different from their natural habitat and they have to bear with a variety of adverse factors for healthy growth and survival. So emphasis should be laid on native species as far as possible. The earlier rulers of the princely states of Kerala considered planting trees along roadsides as a service to the people. Their choice was entirely native species such as Mango *(Mangifera indica),* Jack *(Artocarpus heterophyllus),* Vellappayin *(Vateria indica),* Undappayin *(Vatica chinensis)* etc. which can be seen along the roadsides to-date. Some of them are more than a century old.

In tropics, avenue trees should be preferably of evergreen type that provide shade during summer. Since the roads of Kerala are not so wide, trees with dense oblong crown will be suitable. For landscaping, trees with attractive flowers are more suited. Trees with different flowering seasons can be chosen so that throughout the year at least a few will be in flowers. Combination of trees with various flower colours is also important. An avenue, with trees of a single species having uniform crown shape, creates a much better appearance than the one with different species having different crown shapes. For attaining the uniform crown shape necessary pruning operations are necessary. The planting method and arrangement are also very important in improving the aesthetic value. Plants should be of the same age and are to be planted at equal distance in a straight line.

Protection of trees against pests, diseases, injury to stem and roots is very important in the maintenance of avenue trees. During early stages the plants should be protected from grazing. Damage of terminal bud results in deformed crown shape. Mechanical injury to the bark should be prevented. It is often through the injured bark the pathogens gain entry into the stem and cause decay and death. Dumping large granite stones around the trees, driving nails into the stem for displaying boards etc. should be prevented, While cutting trenches near the trees, care should be taken not to damage roots. Burning of waste materials and dumping of toxic chemicals near the trees are to be avoided.

Most of the species planted as avenue trees in Kerala are exotics *(Peltophorum* sp. *Delonix regia,* etc.). The only merit with these exotics is that they produce attractive flowers. These are preferred for faster growth during the early stages. But most of them have shallow root systems and are susceptible to uprooting with time. Further, they are prone to attack by various pests and diseases and do not provide shade during summer.

A few of the native lowland evergreen species such as *Diospyros microphylla, Carallia brachiata, Mimusops elengi, Mangifera indica* (wild type) *Strombosia ceylanica, Vateria indica, Filicium decipiens, Artocarpus hirsutus, Calophyllum apetalum, Pongamia pinnata, Aglaia roxburghiana, Ormosia travancorica* are worth trying. These species besides their aesthetic appearance, yield valuable timber, that can be put to a variety of end uses.

**N. SASIDHARAN**
Division of Botany (Taxonomy)

# Criteria and Systems for Classifying Vegetation

There are different systems for classifying natural vegetation. Based on certain generally accepted criteria all the systems are formulated. The major criteria for classifying vegetation are given here in an abstract form.

I. PROPERTIES OF THE VEGETATION

A. Physiognomic and structural criteria.
   1. Certain life forms or growth forms
      a. Dominant life forms
      b Combination of life forms
   2. Vertical stratification (layering) and organizational development (the complexity in structure as produced by arrangement of different life forms).
   3. Periodicity

B. Floristic criteria
   1. A single plant species (in special cases 2-3).
      a. The dominant species (in terms of height, cover or combination of both).
      b. The most frequent species (or most numerous species).
   2. Certain group of species.
      a. Statistically derived plant groups
         i. Constant species
         ii. Differential species
         iii. Character species
      b. Plant groups derived without using vegetation statistics.
         i. Species of same ecological significance.
         ii. Species of same geographical significance.
         iii. Species of same dynamic significance.

C. Numerical relation criteria (Community coefficient)
   1. Between different species.
   2. Between different communities.

II. PROPERTIES OUTSIDE THE VEGETATION

A. The presumed final stage in vegetation development (Climax).
   1. Defined by life form combination.
   2. Defined by floristic criteria.

B. The habitat or environment.
   1. Certain site factors
      a. Climate
      b. Water relations
      c. Soil
      d. Anthropogenic influences (management practices)
   2. Combination of site factors.

C. Geographical location of communities.

III. PROPERTIES COMBINING VEGETATION AND ENVIRONMENT

A. By independent analysis of vegetation (in sense of 1) and indepenident analysis of environmental components and subsequent correlation (e. g. through matching of map units).

B. By combined analysis of vegatation and environment and emphasis on interdependencies in the functional sense.

Based on the above mentioned criteria the vegetation was classified in to differert systems. Some of the best known systems are as follows.

1. The physiognomic classification of Grisebach (1872) and Drude (1902).
2. The environmentally oriented classification of Warming (1909) Graebner (1925) and Sukachev (1932).
3. The physiognomic-ecological classification of of Schimper (1898), Diels & Mattick (1908), Brockman-Jerosch & Rubel (1912), Du Rietz (1921) and Rubel (1933).
4. The areal-geographic-floristic classification of Schmid (1963)- based on geographical distance of species.
5. The dynamic floristic classification of Clements (1916, 1928), Tansely and other American & British ecologists - based on the final stage of vegetation development.
6. The floristic structural classification of Cajander (1909) and Braun-Bblanquet (1928).

Each of hese systems has certain advantages and disadvantages, Their common disadvantage is certain inflexibility in adhering to a predefined consfstancy. Consequently they cannot do justice to the natural variability of vegetation.

**A. R. R. MENON**
Division of Ecology

# Conservation of Wildlife Outside Sanctuaries - a Plea

## Introduction

Forests of Kerala are endowed with rich wildlife wealth and the Wildlife Sanctuaries such as Periyar Tiger Reserve, Silent Valley National Park and Eravikulam National Park are famous for their wild animals. Wildlife Protection Act (1972) provides protection for all forms of wildlife both in sanctuaries and other reserved forest areas. Various management strategies are being practiced for the protection and conservation of animal populations there. Apart from these well managed sanctuaries, wildlife thrives in other reserved forests also. The status and distribution of wild animals in those tracts are ill understood.

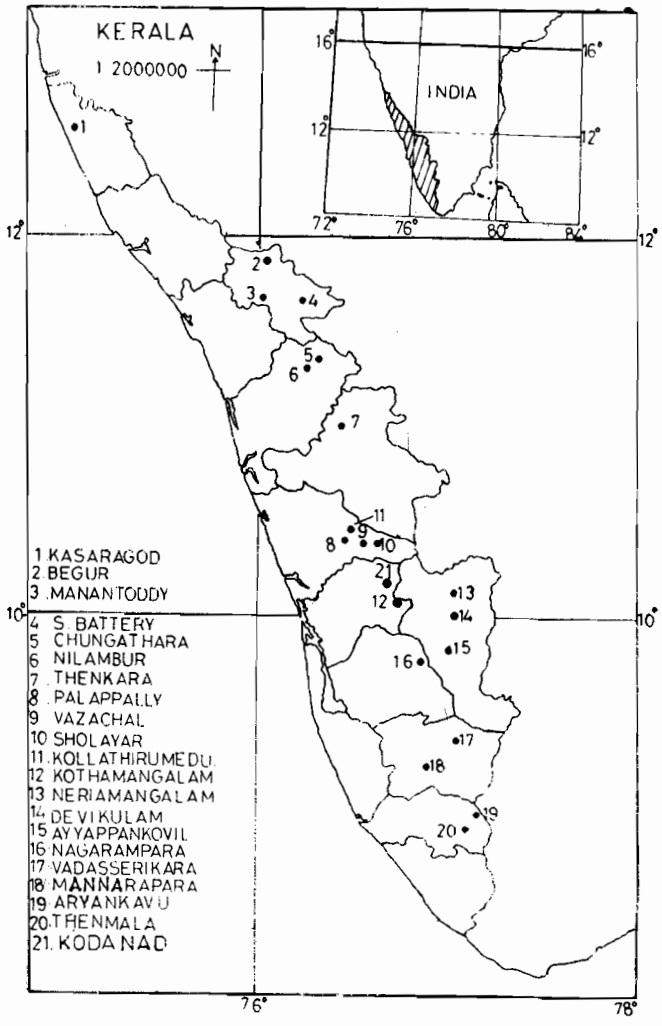


Fig. 1. List of places contacted

In order to gather information on the status and distribution of important wild animals in the reserved forests, other than the notified wildlife sanctuaries a questionaire survey was carried out covering selected areas. Data obtained from different places were mainly based on experience of the concerned forest officials. Information relating to the presence or absence of 28 important wild animals received from 21 places (Fig. 1) are discussed.

## Herbivores

Of all the major herbivores, viz., elephant, bison, Nilgiri tahr, sambar deer, spotted deer, wild boar, hare, barking deer and mouse deer, elephant and wild boar are reported from all the places while gaur and spotted deer from only limited areas. Spotted deer is not reported from Southern Kerala. Out of the 21 places eight places do not contain any population of gaur. The absence of gaur from most of the locations may be due to the constant habitat deterioration and uninterrupted poaching. Sambar deer, shows homogenous distribution from north to south. Barking deer is reported from eighteen places and mouse deer from almost all the tracts.

## Carnivores, rodents and civets

Among carnivores tiger and leopard are reported from eleven locations. Distribution of wild dog, is more or less even and is reported from seventeen locations.

Rodents are found in large numbers throughout. Malabar giant squirrel was absent only in two places. Flying squirrel is distributed uniformly. porcupines, hare, small Indian and toddy cat are distributed throughout.

## Non-human primates

Among the primates of Kerala, bonnet macaque enjoys wide distribution. It is reported from nineteen locations during the present survey. Slender loris, is found at eight places outside the sanctuary limits.

Hanuman langur (common langur) is accounted from the northern part of the state adjoining Karnataka. Lion tailed macaque, found in evergreen forests is not recorded from anywhere.

## Other animals

Out of the three types of bears found in India, sloth bear alone is seen in Kerala and is reported from ten places. Otter is reported from fourteen places and pythons thrive at 17 localities. No information on the presence of crocodiles is received from any of the places.

## Discussion

Those reserved forests where there was a remarkable concentration of such animals compared to adjacent areas were declared as Wildlife sanctuaries, tiger reserves and national parks. Due to this procedure a feeling has developed that other areas do not qualify for the protection of wildlife, eventhough Wildlife Protection Act (1972) is applicable to the entire State.

From the present survey it is inferred that there is a relatively high animal population outside the sanctuary limits too. For example, animals such as elephants, sambar deer, spotted deer, porcupines, hare, gaur and giant squirrel, have a wide distribution outside the sancturies also. At present, the protection and conservation of wild animals outside the Wildlife sanctuaries are in jeopardy. From figure-2 it is further evident that the Wildlife sanctuaries, tiger reserves and national parks are kept as isolated islands for animal populations. There is no connection or continuation between them. Island populations will initiate the processes of inbreeding which will deteriorate the status of individuals and the gene pool as a whole. In order to avoid this, we should extend

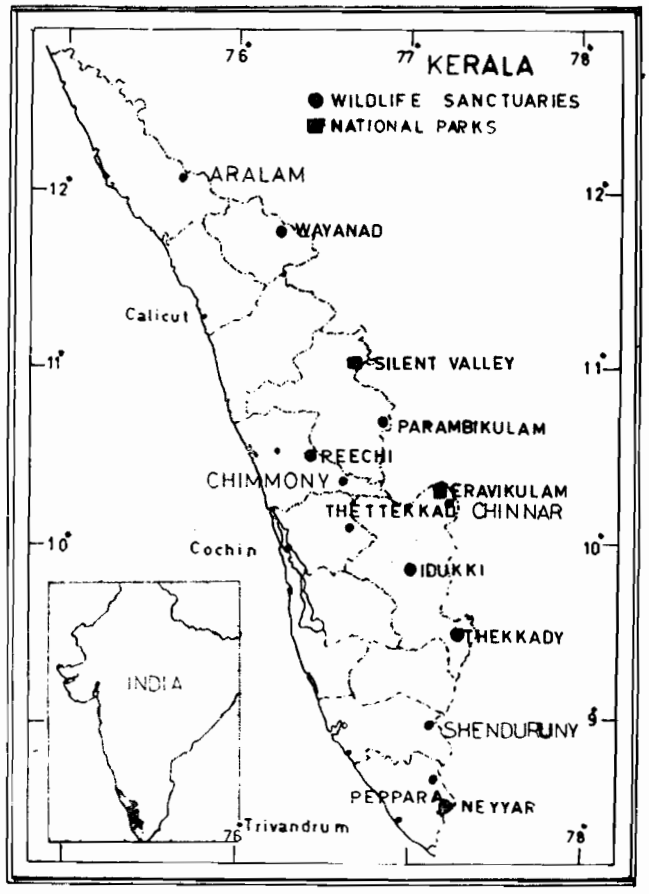


Fig. 2. Wildlife Sanctuaries and National Parks in Kerala

the practice of wildlife conservation to all reserved forests and plantations in its totality. Isolated animals wait for the prowling of conservation minded managers.

**E. A. JAYSON**
Division of Wildlife Biology

# Plant Protection Chemicals - II

## Fungicides

In plant diseases control, use of chemicals play a very important role, as most of the diseases caused by fungi can be controlled or managed by the use of chemicals. These chemicals called fungicides, are used either as eradicants or protectants or systemic compounds. Protectants are those chemicals which provide protection against infection at the site of application. Eradicants cure an established infection at the site of application. Systemic fungicides which are of recent origin, are those which can prevent development of infection in parts of the plant, away from the application site. Usually fungicides of this group are absorbed and translocated. The fungicides are classified on the basis of their chemical nature.

## Copper Compounds

BORDEAUX MIXTURE

Bordeaux Mixture is an aqueous suspension of a flocculent, blue, slowly settling amorphous precipitate possessing great tenacity when freshly prepared. Under normal conditions the precipitate consists of cupric hydroxide stabilised by absorbed calcium sulphate. On using, it is presumed that calcium cuprite is formed.

*Formulations available :* The most generally used formulation is 1% Bordeaux Mixture. i. e. one kg of copper sulphate, one kg of quick lime and 100 litres of water.

*Application :* A general protective fungicide for foliar application. It is applied for the control of powdery and downy mildews, blight, leafspot and rot diseases.

COPPER OXYCHLORIDE

*Alternate name :* Fytolan, Blitox, Blue copper, Mycop, Copex, Parrycop.

*Formulations available :* 4-6% Dust and 50% WDP

*Application* : It is a green to bluish green powder and has been developed to replace Bordeaux Mixture. Widely used in the control of leafspots, downy mildews and rust diseases.

*Dosage* : 1-1.2 kg ai/ha. or as 2-3 g Formulation in one litre of water.

## Mercury Compounds

*Organo-Mercuric Compounds*

These are used as seed dressing agents to control seed borne diseases. They should not be used as foliar sprays and are highly toxic to bees. Because of their high toxicity to mammals and high persistance, the use of mercurials should be avoided.

PHENYL MERCURY ACETATE (PMA)

*Alternate name ;* PMA, Agrosan

*Toxicity* : Acute oral LD 50 to rats 10 mg/kg

*Formulation available* : 1% mercury dust

*Application* : Seed dressing agent 1-2 Formulation for one kg of seed.

METHOXYETHYL MERCURY CHLORIDE (MEMC)

*Alternate name ;* Aretan, Agallol, Ceresan, Emisan

*Toxicity* : Acute oral LD 50 for mammals 30-50 mg/kg

*Formulations available* : 2.5%, 3% and 6% mercury

*Application* : As a seed dressing agent and in some cases as soil drench for the control of damping off and rot diseases.

*Dosage* : 1-2 g/kg of seed as seed dresser, 1g/lit. for soil drench.

## Sulphur Compounds

SULPHUR

Sulphur is used as a protective fungicide and acaricide. They are generally safe except to some sulphur-shy varieties.

*Alternate names* : Hexasulf, Flowers of sulphur (sublimed sulphur), Flour sulphur (ground rock sulphur)

*Formulations available* : Dusts available with 15% inert material to avoid "balling", 80% wettable sulphur, 50% colloidal sulphur.

*Application* : Used in the control of powdery mildews and mites.

*Dosage* : As dust 16.5 kg/ha., as spray 2.5 kg ai/ha.

### Dithiocarbamates and Thiuram Disulphide

Compounds belonging to this group are general purpose fungicides used in the control of downy mildews, leafspots, blight and rust diseases.

ZINEB

*Alternate name* : Dithane Z-78

*Toxicity* : Acute oral LD 50 for rats > 5200 mg/kg

*Formulations available* : 75% WDP

*Application* : A foliar applied protective fungicide. Non-phytotoxic except to zinc shy varieties. Used against leaf spot, blight, mildew and rust diseases.

*Dosage* : 1.5-1.75 kg ai/ha or as 2-3 g formulation/lit. of water.

*withholding period* : Two weeks

ZIRAM

*Alternate name* : Zirlate, Ziram, Cuman

*Toxicity* : Acute oral LD 50 for rats 1,400 mg/kg

*Application* : Protective fungicide for the control of early blight, anthracnose and leaf spot disease

*Dosage* : 1.5 - 1.7 kg ai/ha or 2-3 formulation / lit.

*Withholding period* : Two weeks

MANCOZEB

*Alternate name* : Dithane M-45

*Toxicity* : 6000 mg/kg for rats

*Formulation available* : 75% WDP

*Application* : Foliar applied protective fungicide effective against a wide range of foliar diseases

*Dosage* : 1.5-1.75 kg ai/ha or 2-3 g formulation/lit.

*Withholding period* : Two weeks

THIRAM

*Alternate name* : Thiride, Hexathir or TMTD

*Toxicity* : 350-850 mg/kg for rats

*Formulation available* : 75% WDP

*Application* : Used as foliar sprays and seed dressers. Found effective in pre and post-emergence damping off.

*Dosage* : 1.5-1.7 kg ai/ha, 2-5 g/lit. or 3 g/kg as seed dresser

*Withholding period* : Two weeks

### Trichloromethyl Tin Compounds

CEPTAN

*Alternate names* : Orthocide 40, Hexacap, Captaf

*Toxicity* : 9000 mg/kg for rats. Often may cause skin irritation

*Formulation available* : 80% WDP

*Application* : Protective fungicide and seed dressing agent against a wide variety of diseases. Should not be used on fruits meant to be canned as it causes "tainting".

*Dosage* : 1.2 kg ai/ha, 3 g/kg as seed dresser

*Withholding period* : Two weeks

### Systemic Fungicides

Systemic Fungicides are those chemicals which on application to various plant parts are absorbed by the plant tissues, translocated upwards or downwards, acting directly on the pathogen or through its metabolic products, control plant disease away from the place of application. But in case of non-systemic fungicides, the efficacy depends upon its correct placement in relation to the pathogen. This limitation can be overcome by the use of systemic fungicides. Here also, the fungicides are classified according to their chemical nature.

### Acylalanines

METALAXYL

*Alternate names* : Ridomil, Aprom

*Toxicity* : 669 mg/kg for rats

*Formulations available* : 25% WP for foliar application, 1.2 & 5 g for soil treatment, 35 SD for seed treatment

*Application* : As a seed dresser controls pre-and post-emergence damping off. Foliar applications control airborne diseases especially downy mildews. Soil application controls late blight disease, collar rot, clump rot and damping off.

*Dosage* : 3.5 g/kg as seed treatment, 125-250 g ai/ha as foliar and 2-2.5 g ai/$m^2$ for soil treatment

### Benzimidazoles

These compounds possess broad spectrum of activity to various kinds of fungal diseases.

BENOMYL :

*Alternate name :* Benlate
*Toxicity :* 9590 mg/kg for rats
*Formulation available :* 50% WP
*Application :* Used on a variety of foliar diseases especially wilt diseases. Seed treatment controls root rot and wilt diseases
*Dosage :* 1-2 g/kg as seed treatment, 125-150 g ai/ha as foliar spray and 0.05 - 0.1 % ai. as dip.

CARBENDAZIM

*Alternate name :* Bavistin
*Toxicity :* 6400 mg/kg for rats
*Formulation available :* 50% WP
*Application :* Effectively controls many seed borne diseases when used as seed dressers. As foliar spray controls anthracnose, leaf spot, powdery mildew, rust, sheath rot, scab, damping off and blight diseases. Used in the control of fruit storage diseases.
*Dosage :* 2-3 g/kg as seed treatment, 125-158 g ai/ha as foliar spray, 0.05%-0.1% ai. as dip

## Carboxamides

CARBOXIN

*Alternate name :* Vitavax
*Toxicity :* 3820 mg/kg for rats
*Formulation available :* 70% WP
*Application :* Carboxin protects and eradicates diseases caused by seed, soil or air borne pathogens, especially smut diseases. Seed treatment controls *Rhizoctonia* blight disease.
*Dosage :* 1-3 g/kg as seed treatment.

OXYCARBOXIN

*Alternate name :* Plantvax
*Toxicity :* 2000 mg/kg for rats
*Formulation available :* 25% EC
*Application :* Useful against rust diseases
*Dosage :* 0.1-0.2% ai as spray

## Morpholines

TRIDEMORPH

*Alternate name :* Calixin
*Toxicity :* 1000 mg/kg for rats
*Application :* Used as a protectant against powdery mildews and leaf spots
*Dosage :* 0.5-0.6 kg ai/ha

## Phosphites

ALUMINIUM TRIS

*Alternate name :* Aliette
*Toxicity :* 5800 mg/kg for rats
*Formulations available :* 80% WP or 10g as granules
*Application :* Used against downy mildew diseases and diseases caused by *Phytophthora* like clump rot.
*Dosage :* upto 4 kg ai/ha

## Organophosphorus Compounds (OP)

Organophosphorus compounds have recently been used to control rice blast disease. In Japan several formulations bearing the trade name Hinosan, Cerezin and Kitazin are marketed.

EDIFENPHOS

*Alternate name :* Hinosan
*Formulation available :* 50% EC
*Application :* It has a specific action against rice blast disease. It is also effective against sheath blight and ear blight diseases of paddy
*Dosage :* 240-400 g ai/ha

KITAZIN

*Alternate name* : Kitazin
*Toxicity* : 238 mg/kg for rats
*Formulations available* : 48% EC, 1.5% dust and 17% granules
*Application* : Reported to be useful against rice blast and stem rot diseases. Foliar spray protects leaf blight, anthracnose and spot diseases.
*Dosage* : 500 ppm

## Thiophanates

THIOPHANATE AND THIOPHANATE METHYL

*Alternate names* : Topsin, Cercobin (Thiophanate) Topsin M and Mildothane (Thiophanate Methyl)
*Formulation available* : 50WP and 70WP
*Toxicity* : 7500 mg/kg for rats
*Application* : Both possess preventive and curative properties. Used in vegetable and cereal diseases control
*Dosage* : 0.05-0.2% ai/lit.

## Miscellaneous compounds

CHLORONEB

*Alternate name* : Demosan
*Toxicity* : 5000 mg/kg for rats
*Formulation available* : 65% WP
*Application* : Used in seed treatment or furrow treatment of seedling diseases especially *Rhizoctonia* and *Pythium* diseases
*Dosage* : 2g/kg for seed treatment, 0.75-1.5 kg ai/ha for furrow treatment.

**M. I. MOHAMMED ALI**
Division of Pathology

# Polymer Products from Wood and Bark

Although almost everyone is familiar with the general utilization of wood and its conversion from the log into the products of everyday use, such as flooring, furniture, building timbers, paper and board products, few realize that wood is also an important raw material in the chemical industry. It has been estimated by CSIRO that only about 24 percent of the timber cut in the forest for milling reaches the ultimate consumer and the remaining 75 percent represents waste in various forms. The field of chemical utilization is the most promising avenue for the useful conversion of a large percentage of this waste because of its ability to use materials of various sizes. It is certain that a closer integration of milling units with other phases of wood utilization will lead to more economical exploitation of our forest resources.

Chemicals had been produced from forest biomass in the past, and these products were important commercial chemicals until the market was lost to the petroleum industry. Because of the great advantage of petrochemicals, wood chemicals received little practical interest. However, for alternative energy, chemical resources have lead to the triggering of intensive research for the production of chemicals and energy from wood. Greater and better utilization of the forest residues provides distinct environmental advantages and decreases the cost of subsequent forest management activities.

The vast amount of the different functional monomers and prepolymers present in the cell walls of wood and bark can be subjected to different end uses. A number of multifunctional hydrophilic monomers, present in the polyols of wood and bark can

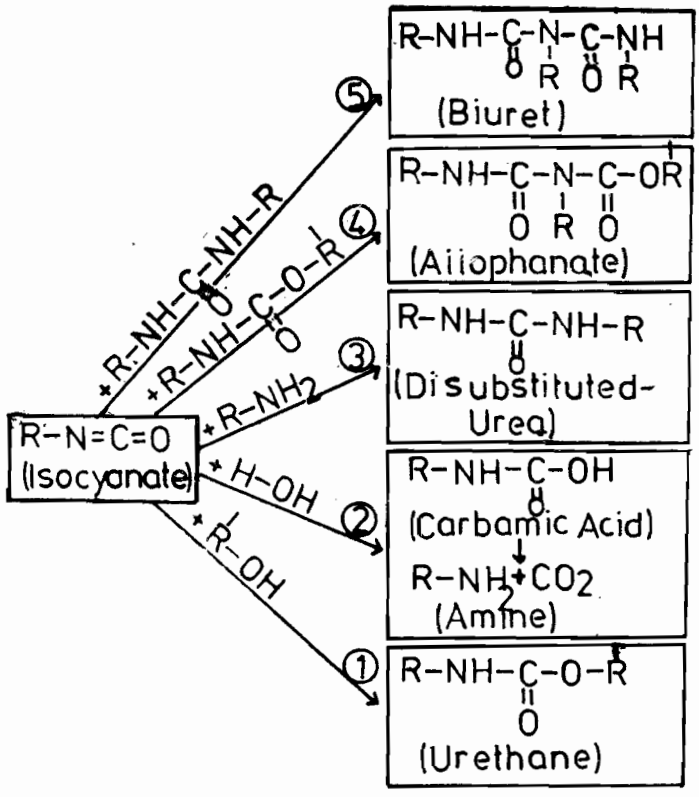


Fig. 1. Chemistry of Urethane foam formation.

be subjected to polycondensation reactions. The use of hydrophilic polyurethanes, polyesters, polycarbonates and polyureas which might result from such polycondensation polymerization reactions could be investigated for different end uses such as, flame retardant materials, thermosetting resins, insulators etc. These high yielding, low-cost polycondensation reactions have not been investigated in the case of wood/bark polyoses and polyols which contain a number of hydroxyl groups.

Polyols are compounds containing many hydroxyl groups. Wood/bark contain richer amounts of polyols. Wood/bark could be used as source of active hydrogen to produce polyurethanes. Similarly, acid chlorides and phosgene analogues could be reacted with compounds possessing active hydrogen to produce polyesters and polycarbonates respectively.

To get an idea about how these polymer products could be derived using wood/bark polyols, a typical case of polyurethane foam formation from synthetic reagents is described (Fig. 1). For simplicity, the chemical reactions are represented in their monofunctional forms here, eventhough all the reactive components must be difunctional or greater to produce a polymeric cross linked structure. The R'-OH stands for polyhydroxyl compound (polyol) in the synthetic system. When considering the wood/bark system the R'-OH stands for polyols present in the same.

The two most important chemical reactions in the preparation of polyurethane foams are the reactions between isocyanate and a hydroxyl compound to form a urethane (Reaction 1) and the reaction between isocyanate and water to form an unstable carbamic acid, which decomposes into an amine and carbon dioxide (Reaction 2). The liberated $CO_2$ itself will work as a blowing agent to a certain extent, for the foam formation. Another reaction taking place is the formation of a disubstituted urea from the reaction of the preceding amine and isocyanate (Reaction 3). Other reactions which lead to branching and cross-linking are the formation of allophanate and biuret linkages. The allophanate linkages occur when the hydrogen on the nitrogen atom of the urethane group reacts with isocyanate (Reaction 4) and biuret occurs when the hydrogen on the nitrogen atoms in the disubstituted urea react with isocyanate (Reaction 5). Similar type of polymerization reactions are taking place in the formation of the other polymer products, viz. polyesters and polycarbonates. The reaction conditions are yet to be optimized for producing the polymer products from wood/bark.

**T. K. DHAMODARAN**
Division of Wood Science

"……We often fool ourselves into believing that the information relevent to a topic is finite. It is increasingly common for some biologists and administrators to treat biological knowledge as a tangible object subject to property laws and sovereignty. In fact, there are no bounds to biological knowledge — discovering one small fact results in the realization that another dozen questions need to be answered. Indeed, living systems are so dynamic and mutable that there some times does not even seem to be stability in biological knowledge",

J. FRAZIER
Smithsonian Institution
Washington D. C., U.S.A.

# Fire and Soil

Vast areas under forest cover get burnt annually by both man-made and natural fires. The effect of fire may be direct as when heat from it is required for seed dispersal, or it may be indirect when by consuming a part of the forest floor, it may provide a suitable seedbed. Similarly, the effects of fire on soils are both direct and indirect.

The duration of fire varies from few minutes to hours in a location. What may be considered harmful resulting from it, is not so much due to the fire as such but to its repeated occurrence in the same area. Thus reduction or prevention of occurrence may be equally disruptive to the environment, although the types of changes will be different.

The most direct effect of fire on soils is the change in energy form of the organic material and its dissipation as heat. Associated changes in soil physical and chemical properties especially close to the soil surface may be both short and longterm. Changes in biological properties are also accompanied. Many of the indirect effects are associated with the process of colonisation of the area with different species.

Much of the variability in the impact is related to the intensity of fire. For wildfires, they are not forseeable to any meaningful degree. Where fire is used as a prescribed tool in forest management, not only can the amount and the condition of the fuel base be controlled but also a choice made in weather conditions during which burning takes place.

The effects of fire on soil properties are the following :

## Effect on physical properties

During a fire, the temperature above, at or below the surface of the mineral soil depends on the amount of fuel, burning conditions and form of soil organic layer at the soil surface. It has been reported that surface temparature may vary from 350-900°C, but at 5-10 cm beneath the surface temperature ranges from 100-150°C. Where roots burn down to a depth in the soil, zones of soil adjacent may be heated for considerable period of time and under these conditions 'firing' or soil minerals is observed. After fire, the darkened surface and the greater insolation received by the soil, increase the heat absorbed.

Soil moisture regimes are usually changed drastically following fire because of the change in vegetation. During burning, certain organic constituents are vaporised, some portion of which moves downward in the soil to form a well defined water repellent layer within few centimetres of soil surface. Following severe burn, the macropore spaces at the surface are reduced and bulk density increased. Also, compaction of surface soil layer can occur as a result of exposure to the beating action of raindrops. Hence infiltration rates are reduced and susceptibility to erosion increased. Severe burning also affects soil structure.

## Effect on chemical properties

Fire increases the soil pH values of surface layers due to the presence of relatively soluble bases in the residual ash. The pH value changes little in mildly burnt areas, while in some other cases from 4.4 to 7 2 when severe burning occurs. The duration of the increased pH varies from at least 10 years to several years depending on cation exchange capacity associated with organic and clay components in the soil.

When burning takes place, ash containing principally Ca, Mg, K and P is produced and this may often be removed by both wind and water movement. The frequency and intensity of fire affects N status of soils; the nature and amount of N are difficult to determine because activity of microflora involved in N transformations is usually altered by changes in organic matter substrate, soil pH and the amounts of readily available nutrients.

## Effect on biological properties

Animals, especially meso and microfauna, usually found in the surface organic layers are particu-

larly susceptible to destruction by fire. Depending upon its intensity, residual population can colonise. There are numerous studies showing the number of soil organisms before and after burning. Results of annual burning have shown general increase in soil organisms in certain cases. While in other cases a decrease or appearance of new individuals have been noted. Also the degree to which the upper soil layers are subsequently exposed to direct sunlight affects their population.

In the case of populations of microorganisms precise nature of change differs from site to site influenced by fluctuations in seasonal moisture condition and soil pH. Similar to soil fauna, the composition and amount of soil microflora vary considerably depending on the intensity of fire. Increase in soil pH values resulting from burning shows increased asymbiotic dinitrogen fixation.

## Fire and ecology

Two immediate results after fire are increase in soil fertility and change in movement of water and exposure to erosional forces. Rapid colonisation of the area largely modifies the exposure to erosion. In initial vegetation development, species known to host symbiotic dinitrogen fixing microorganisms are commonly seen. The litter of this vegetation lasting only a few years, is readily decomposed resulting in more rapid cycling of nutrients in the upper soil layers.

Periodic fire is a major factor in bringing about invasion of forest areas by grasses, resulting in different forms of organic matter distribution in the soil. Studies have shown that the annual death of fibrous grass roots within the mineral soil contrasts with surface litter accumulation characteristics of forest soils, resulting in changing the morphology of the soils markedly. The windthrow process following fire is responsible for both the creation of microtopographic variation and some degree of mixing of the upper horizons of the soil profile.

Considering the effect of fire on soil properties, it can be concluded that it may be beneficial in few cases, while hazardous in moist other.

## References


Armson, K. A. 1977. Forest Soils. Properties and processes. Univ. Toronto Press, Toronto. pp. 224-238.

Jorgensen, J. R. and Hodges, C. S. Jr. 1971. Effects of prescribed burning on the microbial characteristics of soils. *In* Prescribed Burning Symp. Proc., pp. 107-111. USDA Forest Service Southeastern Forest Exptl. Station, Ashewille.

Wells, C. G. 1971. Effects of prescribed burning on soil chemical properties and nutrient availability. *In*: Prescribed Burning Symp. Proc. pp. 86-97. USDA Forest Service Southeastern Exptl. Station, Ashewille. □



**M. BALAGOPALAN**
Division of Soil Science


## 100 Years of Indian Forestry 1861-1961

Vol. II - CHAPTER V

### WORKING PLANS

In 1837, Munro, Superintendent of Forests in Travancore, estimated that in that season about 100,000 trees of teak were fit to be felled in the forests. It is true that he based his figure on his "personal observation and experience of nearly twenty years in the woods"; and judging now by the present-day standards, one might as well have doubted the reliability of the figure. Yet, the idea of fixing and forecasting the annual yield on the basis of some form of computation of the contents of the forest combined with the rate of growth of trees was, indeed, new in the country for his time, and therefore, Stebbing was perhaps right in assuming that, "the credit of having been the first to introduce a simple form of forest working plan in India must be ascribed to Mr. Munro".

# Wood - Some Common Queries - IV

**1 Some timbers, as soon as sawn, tend to warp. What is the reason?**

This is due to the presence of what is known as reaction wood. In logs that have an eccentric pith, the wood on the side having greater growth contains reaction wood. In hardwoods, it is called tension wood. Tension wood is usually formed on the upper side of leaning stems or branches, but a few species form tension wood on the lower side.

There are several features in the surface appearance of wood that indicate the presence of tension wood. The most chracteristic of these is the appearance of a woolly surface in boards that are sawn green. Also, when sawing, thinner sections from tension wood portion, the surface will be rough and the wood will warp.

Tension wood contains higher cellulose and lower lignin than normal wood. This results in lack of stiffness, that is, tension wood is more pliable. Tangential shrinkage is generally higher in tension wood than in normal wood.

**2 What is the effect of acids and alkalis on wood?**

The effect depends on the concentration of acid/alkali, exposure time and temperature. Wood subjected to acid degradation will become embrittled because of the action of acids on the carbohydrate constituents of the cell wall.

The effect of alkalis on wood is much more drastic than that of acids of the same concentration. Alkalis will dissolve part of the hemicellulose and attack the lignin slightly. Wood exposed for a prolonged period of time to alkalis at high temperatures will approach complete solubility (this is one way of making wood pulp).

Alternate exposure to acid and alkali is the most severe service condition to which wood can be subjected. Hydrolysis by the acid produces products soluble in the alkali which in turn swells the fibres, making the wood more permeable to the acid.

**3. What will happen if we mix different species while treating wood with preservative chemicals by vacuum-pressure method?**

Normally, it is not advisable to mix species of different permeability. Some species are very permeable to treatment and some others are very resistant to treatment. This will result in high retention of preservative chemicals in highly permeable species whereas the least permeable species get very low retention. Also, it is good to avoid mixing different sizes of cross-section in the same charge. However, when this is unavoidable, the only acceptable compromise is to treat the charge to a higher retention so that the least permeable timber or timber of large cross-section will at least get the required minimum retention.

**4. Is there any simple device to measure the concentration of preservative solution?**

A hydrometer can be made use of for the purpose. Specific gravity of a solution will vary with the concentration of the solution. As hydrometer measures the specific gravity of a solution, this could be correlated with the solution concentration. First, solutions of known concentration should be prepared (they can be chemically analysed for accuracy) and their corresponding hydrometer readings noted down. Then a graph can be drawn with the above data between solution concentration and hydrometer reading. The hydrometer reading of the solution for which concentration is required is noted down and from this reference graph the corresponding solution concentration can be read.

**5. Will there be problem in gluing preservative-treated wood?**

Some glues are not compatible with certain preservative chemicals and this will result in delamination. For wood treated with copper - chrome - arsenic type preservatives, if it has to be used in wet or dry conditions, resorcinol, phenol or melamine formaldehyde resins are usually suitable, whereas urea formaldehyde and polyvinyl alcohol resins are only

suitable for wood used indoors. Wood treated with organic solvent preservatives can be glued when excess solvent has evaporated. Wood treated with creosote or heavy oil preservatives is unsuitable for gluing.

**6. Would surface moulds reduce the strength of wood?**

The fungi which cause surface mould growths and stains live on the carbohydrates in the parenchyma cells. They can discolour the sawn timber but they do not attack wood. So the strength of wood will not be affected.

**7. What are the factors responsible for the weathering of wood?**

Weathering of wood is brought about by a combination of water, light and heat. The principal cause of weathering is frequent exposure of the wood surface to rapid changes in moisture content. Stresses are set up in the wood as it swells and shrinks as a result of moisture gradients between the surface and the interior. They may result in warping, cupping face checking, surface roughening, grain raising and the formation of small checks and cracks.

Sunlight, particularly the ultraviolet light, degrades the organic materials in wood, particularly lignin. The colour of wood exposed outdoors is affected very rapidly. Generally, all woods change towards a yellow to brown colour which is due to the breakdown of lignin and extractives.

The role of temperature in the natural weathering process is generally felt to be of less importance than those of water and light.

**8 What is the best method of protecting wood used outdoors from weathering?**

There are two basic types of finishes used to protect wood surface during outdoor weathering: (a) those that form a film layer or coating on the wood surface, and (b) those that penetrate the wood surface, leaving no distinct layer or coating. Film-forming materials include paints, varnishes and lacquers. Penetrating finishes include preservatives, water repellents, etc.

Of all the finishes, paints provide maximum protection for wood against weathering. It is good to give a protective treatment which is both water repellent and resistant to decay fungi, prior to the paint finish. The restriction of water from wood is of prime importance in improving the durability of exposed wood.

**R. GNANAHARAN**
Division of Wood Science

"Teak was valued very much by the British from the time they arrived as traders on the West Coast, for use in the Navy. It is stated that teak from Idayara sent by Mathu Tharagan was used in connection with the Battle of Trafalgar".

100 Years of Indian Forestry
Vol. II; Forest Research Institute;
DEHRA DUN (1961)

# Vegetative Propagation - A Means to Enhance the Bamboo Resources

Bamboos are valuable long fibred raw material for paper and pulp industries. In India, of the 4.2 million tonnes of bamboo produced annually, nearly 50% is used by these industries. Ever increasing demand coupled with faster rate of depletion, calls for urgent increase of this resource. Bamboo seeds only once in their life time that too after several years. The viability of seed is also poor. Thus propagation by seeds cannot be successfully employed for raising bamboo extensively, while vegetative propagation is an effective and practical means to achieve this.

## i How to propagate bamboos through culm cuttings?

* Collect 2 to 3 year old culms from healthy clumps of bamboo, during summer months (February to May)

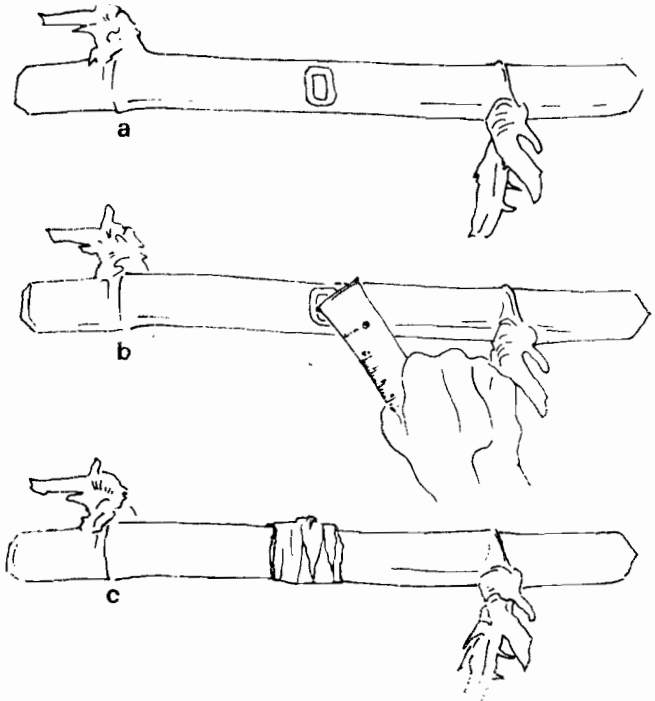


*Figure. 1a.* A two-noded culm cutting of *Bambusa arundinacea* with the opening in the middle of the internode
b Treatment of the cutting with aqueous solution of hormone
c After treatment the cutting is wrapped with a polythene strip

* Make two-noded culm segments from these by cutting at the middle of the alternate internodes and removing side branches and leaves without damaging nodal buds.
* Using a sharp knife, make an opening at the internode of the two-noded culm cutting (Fig. 1a).
* Pour 100 ml aqueous solution of indole butyric acid (IBA) or naphthalene acetic acid (NAA) of 100 ppm concentration into the culm cavity, through the opening (Fig. 1b). (0.1 g of the chemical dissolved in 2 ml of ethyl alcohol and added in 1 litre of water will give 100 ppm solution).
* Cover the opening with a polythene strip (6 cm wide) to avoid spillage of the solution (Fig. 1c).
* Plant the cuttings horizontally in the nursery bed.
* Water the cuttings regularly.

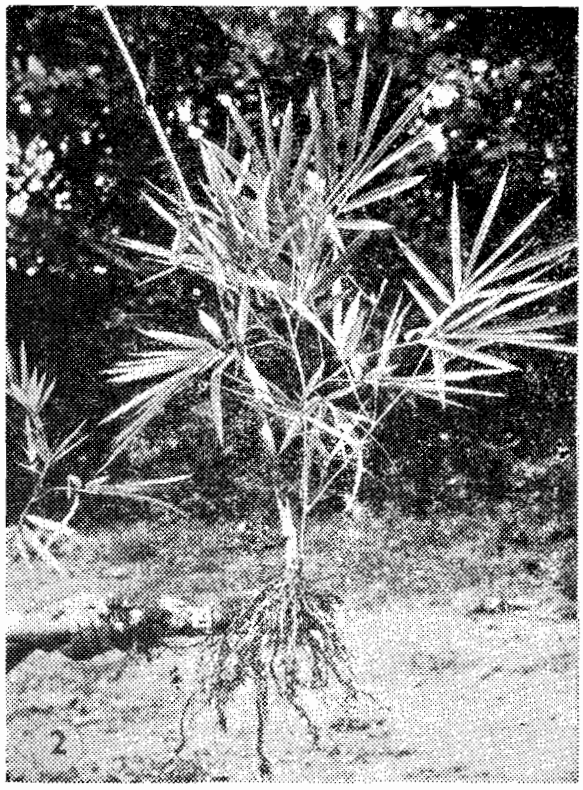

*Figure. 2.* Rooted culm cutting of *Bambusa arundinacea* (after 6 months)

* Provide shade to protect the cuttings from direct sunlight.
* After about six months the rooted cuttings with vigorous sprouts will be ready for field planting.
* If both the nodes are rooted profusely, make it into two propagules by cutting at the middle of culm.

Species successfully propagated using culm cutting:

1 *Bambusa arundinacea* (Thorny bamboo)
2 *Bambusa balcooa* (Assam bolluka)
3 *Bambusa polymorpha*
4 *Bambusa vulgaris* (Golden bamboo/ Tiger bamboo)
5 *Ochlandra travancorica* (Reed bamboo)
6 *Ochlandra scriptoria* (Reed bamboo)

### ii How to propagate bamboos through branch cuttings?

* Collect side-branches from the lower few nodes of the bamboo culm during summer months (February - May)
* Make two-noded cuttings of about 20 cm length, leaving a small portion (5 cm) at either ends of the nodes.
* Dip the lower part of the branch cuttings in aqueous solution of IBA or NAA (100 ppm) for about 24 hours.
* Plant the cuttings vertically in the nursery bed, keeping one node below and one node above the soil level.
* Water regularly and provide shade if necessary.
* The cuttings after proper sprouting and rooting will be ready for field planting within a period of about six months.

Species successfully propagated by branch cuttings:

1 *Bambusa arundinacea*
2 *Bambusa balcooa*
3 *Bambusa vulgaris*
4 *Dendrocalamus strictus*

### iii How to propagate bamboos through nodal-bud-chips?

* After removing side branches from the culm nodes, nodal-bud-chips are separated using a sharp knife (this is usually done while smoothening the bamboos). The nodal buds should be intact with a little culm portion at the base.
* Give hormonal treatment by 'dip-method' as in the case of branch cuttings using aqueous solutions of IBA or NAA at a concentration of 100 ppm.
* Plant the treated nodal-bud-chips with the buds facing upwards in such a way that their basal part is just covered with soil.
* After sprouting and rooting outplant these nodal-buds-chips

Species successfully rooted:
*Bambusa arundinacea*


*Figure 3.* Profusely sprouted and rooted culm cutting of *Ochlandra travancorica* (after 1 year)

Division of Plant Physiology
(For further information contact Division of Plant Physiology, KFRI, Peechi)

# Ailanthus Pests and Their Control

*Ailanthus triphysa* (= *A. malabarica*) is an important matchwood species raised on a plantation scale in Kerala. Two major lepidopteran pests are associated with this tree species.

1. *Atteva fabriciella* (Lepidoptera: Yponomeutidae)

The moths are active at night and lay eggs on tender leaves and on young shoots. The larvae are greenish grey in colour with five longitudinal stripes on the dorsal surface of the body. The larvae are gregarious and are usually seen on the terminal portion of the plant. They web around the tender leaves and feed from within. There are five larval instars. The mature larvae make a pale yellow, loose cocoon and pupate within. (Fig. 1.)

2. *Eligma narcissus* (Lepidoptera : Noctuidae)

The moths are active during night and lay eggs on tender leaves. The young larvae are greenish yellow with white hairs all over the body. Mature larva is bright yellow with black bands on the dorsal surface of the body. Larvae feed on both young and older leaves and are usually seen on the under surface of the leaves. They usually pupate in the host stem inside boat-shaped cocoons, made out of the bark of the host plant. The cocoons match well with the colour of the host stem and are arranged in groups all over the stem (Fig. 2).

The life-cycle of both the insects is completed in little over a month.

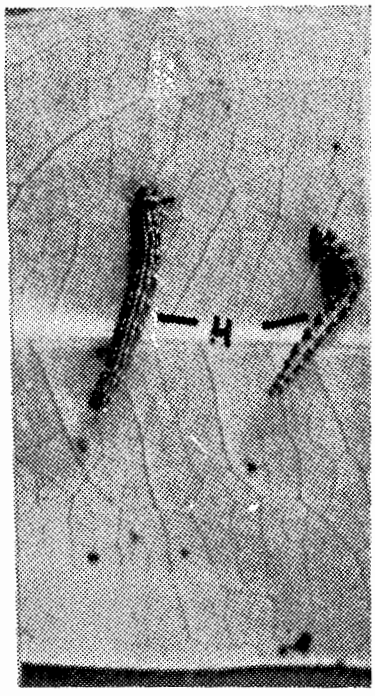

Fig. 1. Caterpillar of *Atteva fabriciella*

## Damage

*A. fabriciella* seems to be a more serious pest, because it feeds on the terminal portion of the plants causing damage to leading shoot. On the other hand larvae of *E. narcissus* feed on all the leaves causing defoliation. Though, new flushes appear in about 2-3 weeks' time, the damage can affect the growth of the plants. Both the pests are of concern, especially in nurseries and in young plantations.

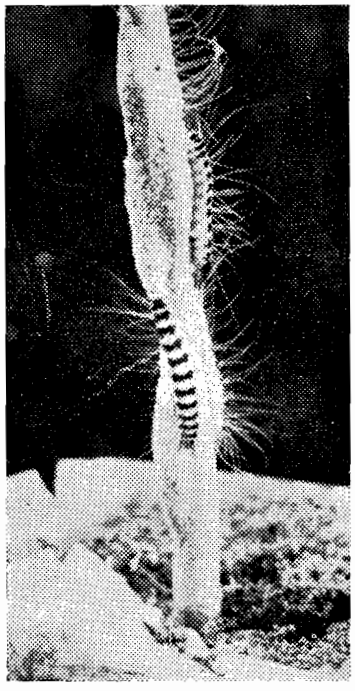

Fig. 2
Caterpillar of *Eligma Narcissus*

## Pest occurrence

Both the pests are widely distributed. The seasonal occurrence of pests is difficult to predict. *A. fabriciella* is present almost throughout the year with a peak in its population between October and December in some localities. The incidence of *E. narcissus* is quite erratic. Though the populations of the two pests do not show any definite pattern during the year the pest population falls during the monsoon period.

## How to control?

In nurseries and young plantations it is possible to control the pests using effective insecticides. One of the effective insecticides, for example, quinalphos (Ekalux 25 EC) at 0.05% may be sprayed. One litre of the above insecticide will be required to cover 1 ha of a 2-year-old plantation. Roughly 200 ml. of spray solution will be required to drench a plant using a rocker sprayer. Care should be taken to drench the terminal portion of the plants very well, where *A. fabriciella* larvae are likely to be present. The insecticide (quinalphos) is not highly persistent and hence the treatment may have to be repeated if fresh outbreaks are noticed. Since the pest outbreaks do not show any definite pattern regular surveillance is required to initiate control measures at the appropriate time.

Pest population build-up is checked to some extent by natural mortality factors like insect parasites, predators and microbial pathogens. Of these, the fungal pathogen, *Paecilomyces farinosus* was found to infect both the pests and a bacterium, *Bacillus firmus* caused mortality of *E. narcissus*. The scope of using these microbial agents for control in a practical way is under study.

**R. V. VARMA**
Division of Entomology

# Carpenterworms - Are They a Threat to Forest Tree Crops in Kerala?

Carpenterworms have gained considerable attention in recent times following their appearance as major pests of several commercially important tree crops in various parts of the world. The adult members of this group of insects are harmless and are popularly known as goat moths (because of the musky odour produced by some members of this family) or leopard moths (on account of the characteristic colouration of certain species).

These insects belong to the family Cossidae under the insect Order: Lepidoptera which comprises the butterflies and moths. The popular name 'Carpenterworms' has reference to the characteristic feeding habit of their immature stages in the woody tissues of various plants. Cossids are mostly restricted to deciduous forests of the temperate and tropical regions of the world. They are generally considered as a primitive group of Lepidoptera since they retain several archaic characters like reduction of mouthparts, presence of vein Cu2 in both pairs of wings etc. Identification of these insects is largely based on the external morphological characters of the adults.

## 1 CARPENTERWORM PESTS OF TREES

### In India

In India, about 25 species of carpenterworms belonging to 6 genera, viz., *Cossus, Duomitus, Azygophleps, Zeuzera, Phragmataecia* and *Eremocossus* have been reported (Hampson, 1892). Of these, the economic importance as well as host range of a few species like *Zeuzera coffeae, Xyleutes ceramica* etc. have already been investigated. The important carpenterworms of various trees in India are the following: the coffee borer *Zeuzera coffeae* attacking about 30 species including mahogany, *Lagerstroemia*, teak and coffee plants; *Z. indica* attacking *Litsea polyantha*; *Z. multistrigata* attacking cherry, sandal and oak; *Z. postexcisa* attacking *Phoebe excelsa* as well as trees of the family Magnoliaceae and Lauraceae (Beeson, 1941). Recently, epidemic build up of *Cossus cadambae*, a species reported to be of minor importance in 1940s has been noticed in several teak plantations in Kerala and Karnataka states.

### In other countries:

Carpenterworms are a major problem for the cultivation of ornamental, horticultural as well as forest tree crops in various countries. The beehole borer, *Xyleutes ceramica* is a major pest of teak in Burma. In Europe, a variety of trees such as alder, ash, beech, birch, elm, maple, oak, poplar, walnut, willow etc. are seriously damaged by the cossid borer, *Cossus cossus*, generally known as the European goat moth. In Finland, poplars (*Populus tremula*) are seriously attacked by *Lamellecossus terebra*. Several fruit trees including avocado, blackcurrant etc. are infested by *Zeuzera postexcisa* (Rybalor, 1975). *Prionoxystus robinae* is a very destructive species in the United States which has got a wide host range including several species of wild, ornamental as well as broad leaved deciduous trees. *Zeuzera pyrina* generally known as the leopard moth is yet another attacking a variety of trees such as ash, apple, beech, birch, cherry, currant, dogwood, elm, hazel, hickory, maple, oak, olive, pear, plum, walnut etc. This insect, a native of Europe, was accidentally introduced into USA. It has also been reported from Egypt (Awadallah, *et. al.* 1983) as well as Israel (Wysoki, 1978) were it attacks pear, avocado and pecan.

From the above discussions, it is very clear that carpenterworms are major pests of tree crops, although the number of species involved is rather limited. Since they mostly attack mature trees, the loss in terms of timber is considerable. Beeson (1941) records 10-15% loss from teak plantations due to the attack by the bee hole borer. Similar figures are available for the other species as well.

It is the polyphagous nature of most species of carpenterworms that promotes their establishment in any geographical area. Moreover, they have a highly prolonged larval period inside the wood which renders early detection and control impractical. The larval feeding habits also lead to considerable damage

to the timber and weaken the plant, subsequently making them susceptible to infestation by phytopathogenic fungi.

Another factor that promotes their establishment is their high fecundity. This is a mechanism to compensate for the high larval mortality rate. For instance, in the teak bee hole borer *X. ceramica,* a single female is estimated to lay upto 50,000 eggs. In another species viz. *X. persona*, this amounts to about 60,000 (Beeson, 1941). This facilitates a steady increase in the population in a short period.

As stated previously the number of carpenterworm pests of tree species is rather limited as compared to those belonging to the other families. In India, only one species viz. *Z. coffeae* was known to build up in epidemic populations, especially in coffee plantations. However, recently, heavy infestation of teak trees by *C. cadambae* (Mathew, 1986) and cherry by *Z. multistrigata* (Bharadwaj, 1982) have been reported. Both these species were earlier considered to be pests of minor importance. This points to the potentiality of most species of carpenterworms in becoming major pests of trees in a short period. Besides *C. cadambae,* small scale infestation of certain forest trees by an unidentified species or *Zeuzera* and *Duomitus leuconotus* have also been noticed in some parts of Kerala. On the whole, the risk of any species becoming major pest of forest trees in the near future is rather small. However, considering the history of other major carpenterworm pests of trees, it will be wise to look out for their occurrence in forest plantations.

## References


Awadallah, A. M., Zaklama, S. F. and Mokhtar, A. M. 1983. Evaluation of certain insecticides and intervals between application for control of the leopard moth, *Zeuzara pyrina* L. on pear trees. *Bull. Ent. Soc., Egypt* No. 11 : 181-186.

Beeson, C. F. C. 1941. Ecology and control of the forest insects of India and the neighbouring countries. Government of India, 767 pp.

Bharadwaj, S. P. 1982. Note on a new record of leopard moth, *Zeuzera multistrigata* Moore (Lepidoptera : Cossidae) on cherry. *Indian Journal of Agricultural Sciences* 52 (12) : 881-882.

Hampson, G. F. 1892. *Moths,* Vol. I in *Fauna of British India,* London, Taylor and Francis 527 pp.

Mathew, G. 1986. Some aspects of the Biology and ecology of the teak carpenterworm *Cossus cadambae* Moore (Lepidoptera, Cossidae) (Abstract only). *National Symposium on Insect Physiology and Behaviour,* Trivandrum 47 p.

Rybalor, L. N. 1975. The leopard moth on black currant. *Zashchita Rastenii* 8:61.

Wysoki, M. and Ishar, Y. 1978. A list of arthropod pests of avocado and pecan trees in Israel. *Phytoparasitica* 6(2) : 89-93.



**GEORGE MATHEW**
Division of Entomology


"..... as population and demands for land and forest products grow and as other types of agriculture progress, intensive plantation culture may prove to be the only economical source of timber in the tropics."

Wadsworth (1960).
5th World Forestry Conference.

*B. rufomaculata* caused the greatest damage, followed by *S. anale*. Monthly or fortnightly application of HCH (0.5%) or borax-boric acid (2% boric acid equivalent) on the exposed surfaces of the stacks did not give adequate protection against the insects. However, debarking the billets before stacking gave satisfactory protection against *B. rufomaculata* and reduced the infestation by *X. similis*. More frequent prophylactic application of insecticide is suggested to reduce the chances of *S. anale* attack.

Muktesh Kumar and N. Sasidharan 1985. Orchids of Kerala and their conservation. *Proc. National Seminar on Biology, Culture and Conservation of Orchids*. April 3-4, Chandigarh.

ABSTRACT

An enumerated list of 186 species of orchids recorded from Kerala is given, which includes 91 species reported to be endemic to South India. 109 species are epiphytic and 77 species terrestrial; among them 5 species are saprophytic. Endangered or presumably extinct species are identified. 13 species are medicinally important. Further exploration to evaluate the status of orchids in the state and the necessity of *in situ* and *ex situ* conservation of the orchid wealth is emphasised.

Muktesh Kumar and N. Sasidharan 1986. On the occurrence of *Dendrobium lawianum* Lindl. in Kerala. *Curr. Sci.* 55(4) : 187-188.

ABSTRACT

*Dendrobium lawianum* Lindl. is a morphologically interesting taxon, the flowers being actinomorphic composed of six equal perianth lobes, with no distinct lip as in other orchids. The species has so far been recorded only from the Karnataka part of the Western Ghats. The present collection from Sholayar, Trichur District extends the range of distribution of this taxon further southwards in the Western Ghats.

K. S. S. Nair and V. V. Sudheendrakumar 1986. The teak defoliator, *Hyblaea puera:* Defoliation dynamics and evidences for short-range migration of moths. *Proc. Indian Acad. Sci.* 95(1) : 7-21.

ABSTRACT

In teak plantation at Nilambur, Kerala, *Hyblaea puera* Cramer (Lepidoptera, Hyblaeidae) caused one or two waves of epidemic defoliations between late April and July, followed in some years by isolated, lighter defoliation between April and November. The insect was absent at other periods, although with a 3 week life cycle it can theoretically pass through several generations per year. The temporal and spatial distribution of infestation and certain behavioural characteristics of populations gave evidence of short range migration of newly emerged moths. In a model proposed for population dynamics of *H. puera* no diapause occurs and a residual, non-migratory population exists in natural forests during the non-epidemic period. With the onset of general flushing of teak in February - March the population starts building up and when a critical density is reached migratory behaviour is triggered. Migration facilitates exploitation of new food sources and escape from larval parasites. Generally, after one or two epidemics, the population declines due to leaf maturity, natural enemies and density-dependent food depletion. This cycle of ups and downs, with attendant transition between migratory and non migratory phases is repeated every year. If some steps of the proposed model are confirmed by further study, simple methods could be devised to manage this serious pest of teak.

C. Renuka and V. P. K. Nambiar. 1986. Axillary shoot development in the aerial stem of Calamus. *Principes,* 29 (4): 160-161.

ABSTRACT

The usual method of reproduction in *Calamus* is through suckers and seeds. But in *C. gamblei* Becc. and *C. hookerianus* Becc. vegetative propagation from aerial parts has been observed. Axillary buds produced at the basal region develop into new shoots. Distal axillary buds, which would have normally developed into flagella are also transformed into new shoots. In both these cases if they happen to come in contact with the soil, roots are produced and they develop into new plants. Otherwise they remain attached to the mother plant and grow. In *C. hookerianus*, in many instances it is observed that roots sprout from the distal nodes which are in contact with the soil. This shows that cane has a potentiality for vegetative propagation.

C. Renuka & K. Swarupanandan 1986. Morphology of the flower in *Thottea siliquosa* and the existence of staminodes in Aristolochiaceae. *Blumea,* 31:313-318

ABSTRACT

The number of stamens in the family Aristolochiaceae range between 6 and 46. This range has

been speculated to be a reduction series. Nevertheless, not even a single taxon within the family is so far known to possess staminodal appendages. Floral anatomical studies of the three morphotypes of the species *Thottea siliquosa* (Lamk.) Ding Hou. referred by three taxonomically synonymous nomenclatural species. viz. *Apama siliquosa* Lamk., *Bragantia dalzellii* Hook. f. and *B. wallichii* W. & A. brought to light the existence of staminodes.

N. Sasidharan and Muktesh Kumar 1985. Three species new to Kerala Forests. *J. Bombay Nat. Hist. Soc.* 82(1):241

ABSTRACT

Three species of orchids namely *Dendrobium mabelae* Gammie, *Smithsonia maculata* (Dalz.) Saldanha and *Pomatocalpa mannii* (Reich. f.) J. J, Sm. are collected for first time from Kerala.

Varma, R. V. and M. I. Mohammed Ali. 1986 *Bacillus firmus* as a new insect pathogen of a lepidopteran pest of *Ailanthus triphysa*. *J. Invertebr. Pathol.* 47:379-380.

ABSTRACT

Field collected larvae of *Eligma narcissus*, a pest of *Ailanthus* sp. were found to be infected by the bacterium *Bacillus firmus*. The bacterium was isolated in pure culture and the pathogenicity of *B. firmus* on *E. narcissus* was confirmed in artificial inoculation experiments in the laboratory. □

# Research Reports

K. M. Bhat, K. V. Bhat and T. K. Dhamodaran: Wood and bark properties of branches of selected tree species growing in Kerala. KFRI Research Report No. 29: Final Report of the project Wood 06/1982. December 1984. 34 pp.

ABSTRACT

In the present system of logging and timber utilistion, branches remain as the major unutilised reserves of the industry. With a view to evaluating raw material quality of branches in relation to those of stem wood properties of eleven selected timber species were studied. The properties examined are density of wood and bark, percentage of bark and heart-wood, proportion of wood components, viz. fibres, vessels, rays and parenchyma and fibre length. The timbers studied are benteak, cashew, coraltree, dhaman, dillenia, gurjan, irul, kindal padri, rubberwood and teak.

No statistically significant difference is found between branches and stem either in wood and bark density or in percentage of fibres, vessels, rays and parenchyma of majority of the species. The average percentage of bark is significantly greater in branches than in stem. It ranges from 10.3 (in benteak) to 28.9 (in cashew) in branches as against 4.8 to 16.2 in stem. Heartwood percentage is considerably lower in the branches. On an average, branch fibre length is 12 percent lower than stem fibre length. Mostly, wood density and bark percentage are higher at the top, while the heartwood percentage and fibre length are greater at the bottom of branches and stem. The coefficients of variation and analysis of variance reveal that with a few exceptions, the variability of these properties among branches and stem is not large. Branch diameter is an important quality parameter as it is correlated with bark and heartwood percentage, fibre length and wood and bark density of certain species. The results of this study suggest that branches can be an additional source of raw material for pulp, paper and board industries.

The among-species comparison, based on statistical test, shows that: (1) Coraltree is low-density (400 kg/m$^3$) timber; cashew comes under moderately low-density (400-550 kg/m$^3$) hardwood and rest of the species are medium density (550-750 kg/m$^3$) hardwoods, irul being the heaviest timber, (2) With average fibre length below 1 mm, cashew is a short-fibred hardwood; dillenia, with average fibre length of 2.7 mm can be included under long-fibred species and rest of the species come under the hardwoods of medium-sized fibres (average fibre length of 1.0-1.5 mm). *Dillenia* is, therefore, of particular interest to the paper industry in meeting the long-fibre needs.

Nair. K. S. S., Sudheendrakumar, V. V., Varma R. V. and Chacko, K. C: Studies on the seasonal incidence of defoliators and the effect of defoliation on volume increment of teak. KFRI Research Report No. 30: Final Report of the project Entom 02/77. December 1985. 78 p.

ABSTRACT

The seasonal incidence of defoliation and its effect on growth of teak plantations were studied at Nilambur, Kerala. Experimental plots established in a

4-year-old plantation were either given selective protection against the two dominant defoliators or left unprotected, over a period of 5 years. The defoliation trend was studied by fortnightly visual scoring. Measurements made on trees felled during the first and second mechanical thinnings were used to establish empirical mathematical relationship between GBH and height on the one hand and volume on the other. Using this relationship, the volumes of the experimental trees were determined at the beginning and end of the experiment. Increments were compared using statistical methods in which the initial volume and the number of neighbours of each tree were used as covariates.

*Hyblaea puera* (Lepidoptera, Hyblaeidae) and *Eutectona machaeralis* (Synonyms: *pyrausta machaeralis, Hapalia machaeralis*) (Lepidoptera, Pyralidae) were the most dominant defoliators. Although the latter was present in small numbers almost throughout the growth season, defoliation caused by it was (1) infrequent over years, (2) generally of low intensity, and (3) occurred late in the season when the leaves were old and rate of growth was low. Defoliation by *H. puera* on the other hand, was a regular annual feature, with one or two waves of epidemic defoliations between late April and July, followed in some years by another lighter defoliation between August and October. A model of population dynamics is proposed based on the findings, according to which, with the onset of general flushing of teak in March-April, the population starts building up, generation by generation, and when a critical density is reached, the newly emerged moths migrate a minimum distance, perhaps 5 to 10 km. Such migration facilitates exploitation of new food sources and escape from larval parasites. Generally, after one or two epidemics, the population declines due to leaf maturity, natural enemies and density dependent food depletion. Until the next flushing season, the population remains small and non-migratory, but active. This residual population is believed to survive mostly in natural forests which provide a small, but continuous supply of tender host leaves during the 'off-season', due to natural phenological variation. This cycle of ups and downs, with attendant transition between migratory and nonmigratory phases is repeated every year. If some steps of the proposed model are confirmed by further study, simple methods could be devised to manage the pest by regulating the early build-up phase.

Generally the trees were in full flush by late April and leaf-fall occurred from December to February. Monthly basal area increment followed a bell-shaped curve, with the highest increments in June, August and September.

The most serious impact of defoliation was loss of volume increment, although in 2 to 4-year-old saplings, defoliation was sometimes followed by die-back of the leading shoot, which in rare cases led to forking. *E. machaeralis* had no significant impact on increment, but *H. puera* caused loss of 44% of the potential increment in volume during the experimental period. When the gain due to protection is expressed as percentage increase over the normally realized unprotected yield, it amounted to 80%. The general applicability of this estimate and its pracitcal significance are discussed. It is concluded that because of changes in stand dynamics brought about by improved growth, it is not possible to quantify the benefit in terms of volume gain for the entire rotation, until adequate models of stand dynamics have been developed. However, the study showed that the benefits are so large that attention must now be focussed on development of suitable methods of protection, rather than more precise estimation of the benefits. Control of *H. puera* is worthwhile, but control of *E. machaeralis* is not. Protection during the early years will be more beneficial because of the greater absolute increment.

Surendran, T. and Seethalakshmi, K. K: Investigations on the possibility of vegetative propagation of bamboos and reeds by rooting stem cuttings. KFRI Research Report No. 31; Final Report of the project Physiol. 02/1979. December 1985. 47 pp.

ABSTRACT

In the present study commercially important bamboos and bamboo reeds of Kerala viz. *Bambusa arundinacea, Dendrocalamus strictus, Ochlandra travancorica, O. scriptoria* and an introduced species *Bambusa balcooa* were successfully propagated vegetatively through culm cuttings. The rooting and sprouting responses were significantly enhanced by the application of one of the suitable growth regulating substances (GRS); indole acetic acid (IAA), indole butyric acid (IBA), napthalene acetic acid (NAA), coumarin or boric acid (BA). Although some cuttings rooted without GRS treatment the development of roots and sprouts was relatively poor. In all the species culm cutting extracted and treated during summer months (February to May) gave better response than in other months. This could be correlated

well with the high temperature and low precipitation prevailing during this period. The treatment to obtain maximum rooting and sprouting responses varied with species. IBA or NAA 100 ppm during March was the most promising treatment for *B. arundinacea* while NAA 100 ppm during February to March was the best for *D. strictus*. The most effective treatment (s) for *O. scriptoria* was IBA 100 ppm in March and for *O. travancorica* NAA 100 ppm or Coumarin 10 ppm in April.

Menon, A. R. R. and Balasubramanyan, K: Species relation studies in moist deciduous forests of Trichur Forest Division (Kerala). KFRI Research Report No. 32: Final Report of the project Ecol. 05/1982. December 1985. 194 pp.

ABSTRACT

Structural and species relation aspects of moist deciduous forest of Trichur division were capsuled in this report. More than 200 localities in the divdsion were visited and vegetational data of 165 selected localities were analysed for the Structural Studies. The plant communities and their successional status (Maturity Index) in different localities were also worked out. The Maturity Index studies reveal that most of the strands selected are moderately mature with respect to their successional status. The phytosociological analysis leading to strand similarity, Continum Index etc. were also done to assess the overall nature of the 'releve'. The Species Distribution Index, the Composite Index like IVI etc., of the vegetation are also incorporated. The quadrat data supplemented will give more useful information regarding the structure and status of the vegetation in general and species in particular. This can be used as a data bank for the area.

The general trend of the species with respect to mutual association has been worked out. Species have been categorized into different groups based on the nature of association. Selection of species for the plantation trails have also been indicated from the positively associated group of species. The species are further grouped into 'medium ranked group', 'character species group', 'secondary species group' etc., based on their association trend. A detailed list of species with positive associations have been incorporated.

To supplement the study, vegetation map at the scale of 1:50,000 has also been appended.

Balasubramanyan, K., Swarupanandan, K. and Sasidharan N. : Field key to the identification of indigenous arborescent species of Kerala forests KFRI Research Report No. 33: Final Report of the project Ecol 02/1979. May 1985. 175 pp.

ABSTRACT

All the previous treatments on the Kerala trees are largely based on generative characters. But, the specimens collected may not always be with generative organs (flowers and fruits). Because of this, experimental and field biologists are often put to difficulties in their identification. Nevertheless, identification at sight, in the field, is often necessary for many practical purposes. For this, an artificial key based on vegetative characters is desirable, besides descriptive floras based mainly on generative characters. To meet this need, the project was undertaken with the aim of generating a convenient key.

A checklist of the dicotyledonous tree species with a minimum of 10 m height, indigenous to the Kerala forests (341 spp.) was prepared from the regional floras. Based on field observations and studies made in the Institute Herbarium, Madras Herbarium (MH) and Central National Herbarium (CAL), a cardex set for characteristics of species was prepared. From this a artificial serial key based on vegetative characters has been compiled.

A systematic compilation of the cardex data in the alphabetic sequence of binomials is given at the end, for convenience. Nomenclaturally correct and taxonomically accepted binomials, whenever available the basionym, the names given in Bourdillon's "The Forest Trees of Travancore" (1908) and Gamble and Fischer's "Flora of the Presidency of Madras" (1915-1935), correct citations, the commonest Malayalam names, family name, detailed annotations of the vegetative characters, a synopsis of the generative characters, ecological details and distribution within the natural forests of the Kerala State are furnished. Indices of binomials and Malayalam names are also appended.

Krishnankutty, C. N., Rugmini, P. and Rajan, A. R.: Analysis of factors influencing timber prices in Kerala. KFRI Research Report No. 34. Final Report of the project Stat 05/1979. December 1985. 21 pp.

ABSTRACT

The study is an attempt to analyse the temporal and spatial variation in timber prices in Kerala and

to identify the factors that could possibly influence such variation.

Average annual prices for 8 species for the period 1956-57 to 1981-82 were estimated from the data collected from the records of the Forest Department. Five-year moving averages, based on real prices obtained by deflating the current prices using wholesale price indices, were utilised to identify the trend. From the analysis it can be seen that prices of all species had increased over the whole period. The period upto 1976-77 was characterised by stable prices and the increase was marginal. A sharp increase in prices for all species was noticed during the period 1976-77 onwards.

Both changes in supply and demand seem to influence the prices. The average annual supply of timber has declined to 69 percent between the periods 1968-69 to 1976-77 and 1977-78 to 1981-82. While supply has declined internal demand has increased, primarily due to growth of the construction activity as indicated by the increase in the number of buildings. Price expectation during sales to consumers seems to be an important factor that determines bid prices. Price expectation, however, depends upon anticipated demand and expected supply. During the period 1976-77 onwards, not only that demand has increased but also supply has declined, and both have cumulatively contributed to a rapid price inrease.

On the basis of the circle-wise real prices of timber for the period 1975-76 to 1981-82 it can be observed that for certain species the prices were consistently high in some circles for most of the years while for some others, such a consistent trend was not noticeable. Local preferences developed over time, availability etc. seem to be the most important factors affecting such regional variation in prices.

Balasundaran, M., Nazma and Gnanaharan, R.: Natural durability of commercial timbers of Kerala with reference to decay. KFRI Research Report No. 35. Final Report of the project Wood 05/1980 - December 1985, 15 pp.

Natural durability of five timber species of Kerala, namely, *Mesua nagassarium*, *Hopea parviflora*, *Vateria indica*, *Vepris bilocularis* and *Vitex altissima*, was studied adopting accelerated laboratory soil-block test method. *Bombax ceiba* was used as reference timber. Test fungi included three brown rotters and six white rotters (two species were represented by two strains). Fungi were screened for their aggressiveness and the following aggressive ones, namely, *Lenzites trabea*, *Polyporus palustris* (brown rotters), *P. hirsutus*, *P. sanguinens* and *P. versicolor* (white rotters) were used in the further study.

Wood of *M. nagassarium*, *H. parviflora* and *V. altissima* lost less than 10 percent weight when exposed to any test fungus and these timber species are grouped under 'highly resistant'. Wood of *V. indica* was 'resistant' against all the fungi, even though it was rated as non-durable by the graveyard stake test. *V. bilocularis* was highly resistant against *L. trabea* but in general, it is only moderately resistant.

Significant inverse correlation between density and percentage weight loss was found in the case of *H. parviflora* and *V. bilocularis*. However, this relationship was either poor or not consistent in the case of other timber species.

Among the brown-rot fungi, *P. palustris* was the most aggressive and among the white-rot fungi, *P. versicolor*. These two fungi could be used as representative test fungi.

Sharma, J. K., Mohanan, C. and Maria Florence. E. J.: Disease survey in nurseries and plantations of forest tree species grown in Kerala KFRI Research Report No. 36 : Final Report of the Project Pathol (F) 01/1979, December 1985. 268 pp.

During the disease survey in *Tectona grandis*, *Bombax ceiba*, *Ailanthus triphysa*. *Gmelina arborea*, *Dalbergia latifolia*, *Ochroma pyramidale* and *Eucalyptus* spp. a total of 65 pathogenic and 13 other diseases (unknown etiology, non-infectious and phanerogamic parasite) were recorded. With these diseases altogether 88 pathogens were associated, of which 64 are new host record including seven new species viz. *Pseudoepicoccum tectonae* and *Phomopsis varisporum* on *T. grandis*, *Meliola ailanthii* on *A. triphysa*, *Griphosphaeria gmelina* on *G. arborea*, *Physalospora dalbergiae* on *D. latifolia* and *Cytospora eucalypti* and *Valsa euclyapticola* on *Eucayptus* spp., while 29 are first record from India.

*T. grandis* had fifteen diseases, two in nursery and fourteen in plantations; one being common to both. Ten organisms were associated with these diseases; mostly causing foliar damage. Six pathogens are new host record and four first record from India. None of the two diseases in nurseries were serious

whereas in plantations die-back caused by insect-fungus complex and a phaenrogamic parasite, *Dendrophthoe falcata* were serious diseases capable of causing large-scale destruction. Three diseases viz. pink disease *(Corticium salmonicolor),* Phomopsis leaf spot and a disease of unknown etiology appeared to have potential to become serious.

In *E. ceiba* there where eight diseases, four in nursery and six in plantations, two were common to both. Four pathogens are new host records. Collar rot and seedling blight were the severe diseases causing appreciable loss to stocking. None of the plantation diseases were found to be serious, except Myrothecium leaf spot which in certain humid areas could pose some problem due to extensive premature defoliation.

*A. triphysa* had a total of nine diseases of which eight were in nursery and four in plantations; three were common to both, All the eight pathogens are new host record while two were first record from India. Among relatively large number of seedling diseases, two viz. collar rot and seedling blight were very widespread and damaging as they resulted in large-scale mortality. In plantations though none of the diseases were very serious, three viz. Botryodiplodia stem canker, pink disease and shot-hole were potentially serious, especially the former two, which killed the affected trees in certain localities.

There were ten diseases in *G. arborea,* three in nursery and eight in plantations; one was common to both. All the ten pathogens associated with these diseases are new host records while three are recorded for the first time from India. In nurseries only seedling blight was of serious consequences though stem infection *(Phoma nebulosa)* also appeared to be potentially serious in certain localities. In plantations a die-back disease caused by *Griphosphaeria gmelinae* was the major disease as it resulted in heavy mortality.

In *D. latifolia* none of the four diseases of foliage recorded were of serious nature. Leaf spots caused by *Physalospora* and *Colletotrichum* are new disease while for leaf rust and Phyllachora leaf spot. *D. latifolia* is a new host.

Only two diseases were recorded in plantation of *O. pyramidale* and none in the nursery, One of the diseases, die-back, resulting in large-scale mortality, was caused by two pathogens, *Calonectria rigidiuscula* and *Fusarium moniliforme,* the former being the first record from India.

*Eucalyptus* spp. recorded the highest number of 30 diseases, 13 in nursery and 21 in plantations; four were common to both. Of the 46 pathogens associated with these diseases 30 are new host record and 18 first record for India. In nurseries, damping-off, seedling blight and leaf and shoot blights were serious seedling diseases affecting the nursery stock considerably, especially in high rainfall areas. In plantations, pink disease and leaf and shoot blights (Cylindrocladium spp.) were the major limiting factors during the first one to three years of establishment. A number of provenances of various species of *Eucalyptus* screened against pink disease following toxin bio-assay revealed variation in susceptibility between species and within provenances of a species. Other potentially serious diseases were web blight *(Rhizoctonia solani)* in nursery and stem cankers caused by *Cryphonectria cubensis* and *Cytospora eucalypticola* (both recorded for the first time from India) which can result heavy mortality.

Control measures for 18 seedling diseases of various tree species were worked out and field tested for the efficacy of the fungicide and its dosage.

Ghosh, S. K., Balasundaran, M. and Mohammed Ali, M. I. Studies on the spike disease of sandal. KFRI Research Report No. 37. Final Report of the project Pathol (NF) 03/1980. December 1985.

Sandal spike disease was first observed in the Reserve 51 of Marayoor forest range, Munnar forest division during June 1980. More than 50 percent of the sandal trees in this reserve had been found to be affected with the disease. Rate of disease spread in two disease monitoring blocks, calculated in terms of apparent infection rate was 0.080 and 0.066 per unit per month. *Zizyphus oenoplia, Stachytarpheta* sp. and *Jasminum rigidum* showing witches'-broom symptoms found in several places in the reserve were suspected to be the collateral hosts of the pathogen.

Histopathological studies, using aniline blue and Hoechst 33258 gave evidence on the occurrence of MLO in the diseased phloem tissues. The technique could be used as an easy method of disease detection. Electrophysiological studies using Shigometer indicated a positive correlation between severity of the disease and electrical resistance of inner bark in diseased trees. Though TEM studies showed large number of MLOs in the phloem tissues, attempts to culture the organisms *in vitro* were not successful. *Redarator bimaculatus* was identified as an insect

vector of spike disease through disease transmission studies and by the presence of MLO in the tissues of intestine and salivary glands of the insects, fed on spiked sandal and in the phloem tissues of plants infected through the vector.

Infusion of aqueous solution of 500 mg. of tetracycline antibiotics dissolved in 500 ml. of water in spiked trees gave remission of disease symptoms lasting for three to five months. Repeated infusion of tetracycline-HCl in alternate months for an year did not give complete recovery. Higher doses of tetracyclines i. e., 2 to 8 g/tree prolonged the remission period upto seven to eight months. Infusion of tetracycline at 12 g/tree was found phytotoxic. Combinations of diffefent tetracyclines did not give any additional improvement of antibiotic action. Digitonin and 2-1, guanidinododecane acetate also gave temporary remission of disease symptoms. But cephalaxin did not give any result.

Sudheendrakumar, V. V. : Studies on the Natural enemies of the teak pests, *Hyblaea puera* and *Eutectona machaeralis*. KFRI Research Report No. 38: Final Report of the project Entom 10/1983. February 1986. 23 pp.

ABSTRACT

Information on the natural enemies of the teak pests, *Hyblaea puera* and *Eutectona machaeralis* was collected from three plantation sites at Nilambur, during April 1985.

The natural enemies of *H. puera* recorded include five parasites *Brachymerla lasus* (Walker), *Palexorista solemnis* Walker, *Sympiesis sp.* and two species of unidentified ichneumonid wasps; two insect predators - *Cantheconidea furcellata* Wolft and *Parena nigrolineata* Chd., four species of birds *Corvus macrorhynchos* (Jungle Crow), *Acridothereo tristis* (Common Mynah), *Dicrurus adsimilis* (Black Drongo) and *Turdoides striatus* (Jungle Babbler); and a species of bacterial pathogen *Enrerobacter aerogenes* (Kruse) Hormaeche and Edwards. Among the natural enemies, the parasite *Sympiesis sp.*, the bird predators and the bacteria are new records on *H. puera*. Both the insect predators are new records from Nilambur.

Other than the pupal parasite *B. lasus* all parasites recorded were found infesting the larval stages of the pest. *P. solennis* was the only parasite consistantly recorded from all the study sites during the peak pest infestation period. Though noted during the same period the distribution on the ichneumonid wasps was found restricted to only one of the study sites. *Sympiesis sp.* was recorded only during the second half of the season, when the pest population was generally very small. The overall percentage parasitism due to all parasites ranged from 0 to 28 in 1983 and 0 to 26 in 1984, but during the first epidemic of the pest in each year it was very low or almost absent.

Incidence of predation by *C. furcellata* and *P. nigrolineata* was recorded only rarely. Among the birds, the contribution of *C. macrorhynchos* (Jungle crow) was substantial.

The bacterial pathogen *E. aerogenes* isolated from field-infested *H. puera* larvae was found to be an efficient mortality factor under laboratory conditions.

As no major incidence of *E. machaeralis* occurred during the study period very little information could be gathered on its natural enemies. Five species of parasites recorded include, *Apanteles sp. Brachymeria hime atteviae* Joseph *et al.*, *Phanerotama hendecasisella* Cam. and two species of unidntified ichneumonid wasps.

# Seminar, Congress, Lectures

Dr. T. G Alexander, under the sponsorship of East-West Centre/Environment and Policy Institute, Hawaii, participated in the Regional Workshop on the roles of agroforestry in site protection and amelioration held at the Institute of Forest Conservation, Los Banos, Philippines from 4-10 September, 1985 and presented a paper "Taungya and soil management during establishment phase of forest plantations in Kerala".

Dr. K. S. S. Nair, Dr. George Mathew and Dr. V. V. Sudheendrakumar attended the National Seminar on Entomophagus insects and other arthropods. held at Calicut on 9-11 October, 1985. Dr. Nair presented a paper entitled 'Migration mechanism of parasite evasion'; Dr. Mathew presented a paper entitled 'Natural enemies of some timber borers in Kerala and their possible role in regulating pests incidence'; and Dr. Sudheendrakumar presented a

paper entitled 'The role of parasites in regulating populations of *Hyblaea puera* in teak plantations'.

Shri.M.I.Mohammed Ali attended the 8th IUFRO Mycoplasma Conference, held at Indian National Science Academy, New Delhi from 13-15 December 1985 and presented three papers, entitled: 'Studies on little leaf disease of eucalypts' by M. Balasundaran, M. I. Mohammed Ali, S. K. Ghosh and V. Sundaraman, and 'Association mycoplasma-like bodies in the insect transmitted spike disease of sandal' by M. I. Mohammed Ali, M. Balasundaran and S. K. Ghosh.

Shri. K. Shanmuganathan and Dr. J. K. Sharma attended a meeting of Southern Regional Silviculturists and Forest Research Workers Conference at Bangalore from 1-4 January, 1986.

Dr. R. Gnanaharan attended the Workshop on 'Building Materials-their availability, production and use' at Trivandrum on 24 January 1986 and presented a paper entitled 'Application of wood and wood products for building construction'.

Dr. R. V. Varma and Dr. George Mathew attended a symposium on insect physiology, ecology and behaviour held at Trivandrum on February 18-20 1986. Dr. Varma presented a paper entitled 'Seasonal occurrence and factors regulating the populations of major pests of *Ailanthus*' and Dr. George Mathew presented a paper entitled 'Some aspects of the biology and ecology of the teak carpenter worm *Cossus cadambae*'.

## Campus News

Joined KFRI recently — K. M. Velayudhan
Left KFRI — Dr. S. Kedharnath, Director

## Visitors

1. Dr. A. J. Bolton
   University College of North Wales
   Bangor
   England.
2. Prof. Allan A. Berryman
   Washington State University
   U. S. A.

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# Obituary

**Miss. M. V. MARY**

**(1951 03 25 - 1986 04 10)**

With deep anguish we had to face the sudden passing away of Mary. Mary remained pleasent throughout her stay in the Institute and she succumbed to ill health in the latter days. Born and brought up in rural environment, she went through life in a hard way and fought until the last for what she stood for. She worked hard and held on to truth, love and beauty constantly. She leaves her parents, brother, host of relatives and friends, and colleagues in the Institute to mourn.

STAFF K. F. R. I.

# Forthcoming Events

10-16 AUGUST, 1986. 4th Congrees of the International Association for Ecology (INTECOL). Syracuse, New York. USA

Contact: Prof. F. B. Golley, Institute of Ecology, University of Georgia, Athens, GA 30602, USA.

10-17 AUGUST, 1986. 6th International Congress on Pesticides. Ottawa, Canada

Contact : Dr. H. V. Morley, Station de Recherche Agricole de l'Universite', Sous-Bureau Postale Universitaire, London, Ontario, Canada

13-20 AUGUST, 1986. 13th International Congress of Soil Science (ISSS) Hamburg, Federal Republic of Germany

Contect : ISSS Secretariat, International Soil Museum, 9 Duivendaal POB 343. 6700 AJ Wageningen, Netherlands

6-9 OCTOBER, 1986. 22nd Dvelopment Treds and Florence, Atanely (Theme : EUCIEP Conference. in the Science and Technology of Pulp and Papermaking)

Contact : OIC, Via G. Modena, 19,50121 Firanze, Italy. Telex ; 580071 OICI

12-17 OCTOBER, 1986. Tree Improvement - Theory and Practice (IUFRO Working Parties S2.04-03 Progeny Testing and S2. 03-03 Seed Orchards) Williamsburg, Virginea, USA

Contact : R. J. Weir, North Carolina State University, Box 8002, 1019 Biltmore Hall, Raleigh NC 27695-8002, USA

21-23 OCTOBER, 1986. National Seminar on Environmental Pollution Control and Monitoring, Chandigarh

Contact : Dr. V. S. Bhatnagar, Chairman Environmental Monitoring Instruments Division P. B. 76(GPO) CSIO Sector 30, Chandigarh 160020

22-25 OCTOBER, 1986. International Seminar on Structure and Function of Enzymes. Banaras Hindu University, Varanasi

Contact : Prof. O. P. Malhotra, Dept. Biochemistry, Faculty of Science, Banaras Hindu University, Varanasi, 221005 India

9-13 NOVEMBER, 1986. Woodmex '86. International Woodworking Equipment Exhibition. National Exhibition Centre, Birmingham, UK

Contact : Woodmex '86, 11 Manchester Square, London WIE ZQZ, UK

25-31 JANUARY, 1987. Land and Resource Evaluation for National Planning in the Tropics, Chetumal, Mexico

Contact : Mr. H. Gyde Lund, Program Chairman, C/o USDA Forest Service, TM, PO BOX 2417, Washington DC 20013, USA. Tel: (202) 475-3747

7-16 FEBRUARY, 1987. Gifex '87 - Ghana International Furniture and Woodworking Industry Exhibition

Contact : Gifex '87, P. O. Box 32, Trade Fair Site, Accra, Ghana

6-10 APRIL, 1987. Symposium on Silviculture and Genetic Improvement of Forestry Species. Buenos Aires, Argentina

Contact : Ing. Daniel Maradei, CIEF, Moreno 431, 1091 Buenos Aires, Argentina. Tel: (01) 33-3020 and 30-4930

20-30 AUGUST, 1987. 16th Pacific Science Congress, Seoul, Korea

Contact : Ms. Brenda Bishop, XVI P.S.C. 1987, KPO Box 1008, Seoul 110, Korea

# Farewell

Dr. S. Kedharnath laid down office as the Director, of the Kerala Forest Research Institute on 31-3-1986 after a term of three and a half years. During this term he had brought into play all his versatility and wide experience in forestry research, gained over a period of three decades. The institute was just six years old with the basic infrastructural facilities when he joined and he helped it take off in a dynamic way to its avowed fields of basic and applied research in forestry. His contacts with a host of eminent scientists all over the world was a great asset from which this institute gained national and international stature.

Eminent scientists can never retire. We are sure that Forests and Forestry will continue to enrich themselves, from the vast storehouse that he is. K. F. R. I. continues to look forward his guidance and co-operation.

We wish him a contented and fruitful future.

Dr. C. T. S. Nair, formerly Forest Economist, at K. F. R. I. took charge as Director with effect from 1-4-1986.

# KFRI Research Reports

No. 1* Easwarankutty, K., Sivarajan, M. and Asan, R. B. 1977. Study on wood and bark volumes of eucalypt trees in Kerala. Final Rep. Res. Proj. Stat. 03/1977, 27 pp.

No. 2 (1)* KFRI 1977. Availability of wood raw-materials for plywood industry-Kerala-Karnataka Region. Final Rep. Res. Proj. (Sponsored by the Federation of Indian Plywood and Panel Industry) Part-1,117pp. (Mimeographed).

(2)* KFRI. 1978. Availability of wood raw-materials for plywood industry-North-Eastern Region. Final Rep. Res. Proj. (Sponsored by the Federation of Indian Plywood and Panel Industry), Part-2. 85 pp. (mimeographed).

No. 3* KFRI. 1978. Dipterocarps of South Asia. Final Rep. Res. Proj. (Sponsored by FAO), 637 pp (Typewritten).

No. 4 Alexander, T. G., Sobhana K., Balagopalan, M. and Mary, M. V. 1980. Taungya in relation to soil properties, soil erosion and soil management; Final Rep. Res. Proj. Soils 01/1977, 24 pp.

No. 5* KFRI. 1980. Studies on changing pattern of man forest interactions and its implications on ecology and management: A case study of the Reserved and Vested Forests in Attappady, Kerala. Final Rep. Res. Proj. (Sponsored by the Department of Sci. & Tech.. Govt. of India). 235 pp. (Mimeographed).

No. 6 Nair, K. S. S. and Varma, R. V. 1981. Termite control in eucalypt plantations. Final Rep. Res. Proj. Entom 01/1976, 48 pp.

No. 7 Alexander, T. G., Balagopalan, M., Thomas P. Thomas and Mary, M. V. 1981. Properties of soils under teak, Final Rep. Res. Proj. Soils 02/1977, 13 pp.

No. 8 Alexander, T. G., Balagopalan, M., Mary, M. V. and Thomas P. Thomas 1981. Properties of soils under eucalypts. Final Rep. Res. Proj. Soils 03/1977, 12 pp.

No. 9* Nazma, Ganapathy, P. M., Sasidharan, N., Bhat, K. M. and Gnanaharan, R. 1981. A handbook of Kerala timbers. Final Rep. Res. Proj. Wood 01/1979, 260 pp.

No. 10 Mathew George 1983. A survey of beetles damaging commercially important stored timber in Kerala. Final Rep. Res. Proj. Entom 07/1979. 92 pp.

No. 11* Varma, R. V. 1982 Investigations on the possibility of non-insecticidal control of termites.. Final. Rep. Res. Proj. Entom 06/1979, 28 pp.

No. 12 Gnanaharan, R., Nair, K. S. S. and Sudheendrakumar, V. V. 1982 Protection of fibrous raw-materials in storage against deterioration by biological organisms. Final Rep. Res. Proj. Wood 05/1980, 24pp.

No. 14* Alexander, T. G. and Thomas P. Thomas 1982. Cultural practices for managing soil erosion in foreet plantations A state of knowledge report. Final Rep. Res. Proj. Soils 05/1181, 11 pp.

No. 15 Gnanaharan, R. and Mathew George 1982. Preservative treatment of rubber wood *(Hevea brasiliensis)*. Final Rep. Res. Proj. Wood 03/1977. 16 pp.

No. 16 Nair K. S. S. 1983. Seasonal incidence, host range and control of the teak sapling borer *Sahyadrassus malabaricus*. Final Rep. Res. Proj. Entom 08/1979, 36 pp.

No. 17 Alexander, T. G., Mary, M. V., Thomas P. Thomas and Balagopalan, M. 1983. Infuence of site factors in *Bombax* plantations. Final Rep. Res. Proj. Soils 04/1979, 19 pp.

No. 18* Nair C. T. S. and Muraleedharan P. K. 1983. Rural institution for development of appropriate forestry enterprises: A case study of the traditional reed industry in Kerala State, India. Final Rep. Res. Proj. Econ 03/1982, 150 pp.

No. 19 Nair, K. S. S. Mathew George, Varma R. V. and Gnanaharan R. 1983. Preliminary investigations on the biology and control of beetles damaging stored reed. Final Rep. Res. Proj. Entom 04/1979, 33 pp.

No. 20 Balagopalan, M. and Alexander, T. G. 1983. Organic matter dynamics in teak and eucalypt plantations. Final Rep. Res. Proj. Soils 06/1981, 21 pp.

No. 21* Ghosh, S. K., Balasudaran, M. and Mohamed Ali, M. I. 1984. Studies on host-parasite relationship of phanerogamic parasite (s) on teak and their possible control. Final Rep. Res. Proj. Pathol (NF) 01/1979, 39 pp.

No. 22* Nair, C. T. S. Mammen, C and Muhammed, E., 1984. Intensive multiple use forest management in the tropics. Final Rep. Res. Proj. Econ 04/1982, 184 pp.

No. 23 Alexander, T. G. and Mary, M. V. 1984. Effect of mussoorie phos on the growth of *Eucalyptus tereticornis* seedlings. Final Rep. Res. Proj. Soils 07/1981, 7 pp.

No. 24 Nair, P. V., Ramachandran, K. K., Vijayan V. S., Easa P. S. and Balakrishnan, P. V. 1985. An ecological study in Periyar Tiger Reserve with special reference to wildlife. Final Rep. Res. Proj. Wild 02/1977. 158 pp.

No. 25 Ghosh, S. K., Balasundran, M. and Mohamed, Ali M. I. 1985. Studies on the little leaf disease of Eucalypts. Final Rep. Res. Proj. Pathol (NF) 02/1977, 15 pp.

No. 26 Nair, P. V. and Balasubramanyan, K. 1985. Long-term Environmental and ecological impacts of multipurpose river valley projects: Wildlife studies in Idukki, Periyar and Silent Valley. Final. Rep. Res. Proj. Wild 03/1980. 75 pp.

No. 27 Alexander, T. G. and Thomas P. Thomas 1985. Physical properties of soils in relation to eucalypt growth. Final Rep. Res. Proj. Soils 09/1982, 11 pp.

No. 28 Gopalakrishnan Nair, N. and Sasidharan, N. 1985. Distribution of important forest tree species in Kerala (Central Circle). Final Rep. Res. Proj. 03/1980, 31 pp.

No. 29 Bhat, K. M., Bhat, K. V. and Dhamodaran, T. K. 1985. Wood and bark properties of branches of selected tree species growing in Kerala. Final Rep. Res. Proj. Wood 06/1982, 34 pp.

No. 30 Nair, K. S. S., Sudheendrakumar, V. V., Varma, R. V. and Chacko, K. C. 1985, Studies on the seasonal incidence of defoliators and the effect of defoliation on volume increment of teak. Final Rep. Res. Proj. Entom 02/1977; 78 pp.

No. 31 Surendran, T. and Seethalakshmi, K. K. 1985. Investigations on the possibility of vegetative propagation of bamboos and reeds by rooting stem cuttings. Final Rep. Res. Proj. Physiol 02/1979; 47 pp.

No. 32 Menon, A. R. R. and Balasubramanyan, K. 1985. Species relation studies in moist deciduous forests of Trichur Forest Division (Kerala). Final Rep. Res. Proj. Ecol 05/1982; 194 pp.

No. 33 Balasubramanyan, K., Swarupanandan, K. and Sasidharan, N. 1985. Field key to the identification of indigenous arborescent species of Kerala forests 1985. Final Rep. Res. Proj. Ecol 02/1979: 175 pp.

No. 34 Krishnankutty, C. N., Rugmini, P. and Rajan, A. R. 1985. Analysis of factors influencing timber prices in Kerala. 1985. Final Rep. Res. Proj. Stat 05/1979; 25 pp.

No. 35 Sharma, J. K., Mohanan, C. and Maria Florence, E. J. 1985. Disease survey in nurseries and plantations of forest tree species grown in Kerala. 1985. Final Rep. Res. Proj. Pathol (F) 01/1979: 268 pp.

No. 36 Sudheendrakumar, V. V. 1986. Studies on the natural enemies of the teak pests, *Hyblaea puera* and *Eutectona machaeralis* 1986. Final Rep. Res. Proj. Entom 10/1983; 23 pp.

No. 37 Ghosh, S. K., Balasundaran, N. and Mohammed Ali, M. I. (1985) studies on the spike disease of sandal. Final Rep. Res. Proj. Pathol (NF) 03/1980; 56 pp.

No. 38 Sudheendrakumar, V. V. Studies on the natural enemies of teak pests. *Hyblaea puera* and *Eutectona machaeralis.* Final Rep. Res. Proj. Entom 10/1983; 23 pp.

# KFRI Information Bulletins

No. 1* Chandrasekharan C. 1975. Wood use in Kerala and its implications for forest land use and development, 30 pp.

No. 2 KFRI. 1980. Matti (Perumaram), (Malayalam), 8 pp.

No. 3 KFRI. 1981. Termite control in eucalypt plantations. Division of Entomology, 6 pp. (Pests of eucalypts and their control, revised Malayalam version, 1984, 4 pp).

No. 4 KFRI. 1981. Medicinal plants of Kerala Forest : A tentative checklist (Malayalam & English), Division of Botany, 31 pp.

No. 5 KFRI. 1982 How to establish seed orchards of teak (*Tectona grandis* L.)? (English & Malayalam) Division of Genetics, 10 pp.

No. 6 KFRI. 1984. Nursery disease of eucalyptus in Kerala and their control (English & Malayalam) Division of Pathology (Fungal Diseaaes), 16 pp.

No. 7 KFRI. 1984. Preservative treatment of rubber wood (English & Malayalam), Divisions of Wood, Science & Entomology. 7 pp.

*Note : Publications marked *are no longer available for distribution. For free copies of other publications please write to The Librarian, Kerala Forest Research Institute, Peechi 680 653, Kerala, India.*