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Editor's column

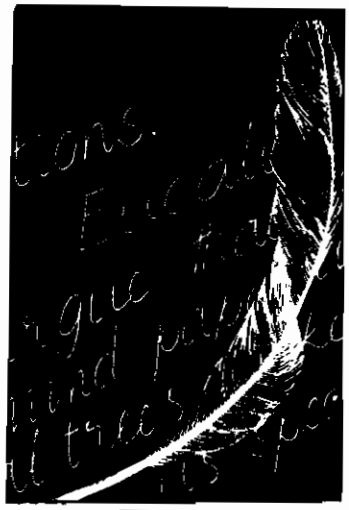
Eucalypts - a controversy

The National Seminar on Eucalypts with the theme '*Eucalyptus* in Indian Forestry—past, present and future', on which the entire country had an eye is over but the dust of two days deleberations is yet to settle down completely. The focal point of the seminar was the two technical sessions 'Eucalypts and social forestry' and 'Eucalypts and socio-economic aspects' which provided the forum for putting forth opinions of two extremes. While some wanted eucalypts to be altogether replaced by indigenous species because of its 'ill effects on the environment' others suggested growing eucalypts extensively even in agricultural fields. In fact people for and against eucalypts argued with emotions rather than with scientific evidences. When the proeucalypt faction blamed others for not providing sufficient scientific data in support of their argument the anti-eucalypt faction questioned the quality and relevance of the data presented by the pro-group supporting their stand. This happened as there was clearly a lack of information relating to effects of eucalypt cultivation on soil erosion, soil fertility, water table, etc. So to an onlooker it was rather a debate than a careful scientific analysis of the situation.

Whether, eucalypts or no eucalypts, exotic or indigenous we need a fast growing species, to meet our industrial and domestic demands. If there are no eucalypts, do we have other promising alternative species for meeting these demands?

It is quite clear that we lack sufficient data on silviculture and utility of indigenous fast growing species. It is high time we shed our emotions and face the problem in a realistic way. Until we fill up the lacunae and come out with proper answers, we can't keep our eyes closed to the great demand for wood and say 'no' to eucalypts. About half a million ha. of forest land in India is under eucalypts and Kerala has six percent of it. Eucalypts are proven for their fast growth and biomass productivity even in poor sites around the world. But in Kerala its performance is not as promising as elsewhere except in some pockets here and there. A large number of eucalypt plantations especially those of *E. tereticornis* situated on the lower elevation of Kerala are poorly stocked and badly affected with pink disease. The yield from such plantations is 30t/ha on an average against 70 to 80t/ha envisaged. We are already in short supply of eucalypt wood to meet the industrial needs. Against the requirement of 3,33,000t we hardly supply 2, 65, 000 t. Whether the species or the management is to be blamed for the failure is yet to be assessed. It is high time that Kerala evolve a scientific solution to this failure. Instead of increasing the area under eucalypts what is needed is intensive management of the existing plantations to maximise yield. Selection of disease resistant species/provenances to suit a particular area should be given the highest priority. It is disappointing that in Kerala we have not given serious thought on these lines even after two decades of eucalypt cultivation. Though such things are often discussed and put on paper, they are hardly practised in field.

This seminar was indeed a success, though not in exchanging scientific experiences, in showing up the lacunae in eucalypt research and giving directions for future course of action. Without loosing much time inter-disciplinary research programme on the impact of eucalypts on environment and the management has to be initiated.



OPINION PAGE

The Editor,
Evergreen.
Sir,

The article 'Some alternative tools and improved techniques in logging ... ...' (September '83) was interesting. I do agree with the author that due to conventional methods of harvesting and converting trees into utilizable sizes a large volume of wood is wasted. For reducing the wood wastage we have to improve our logging operation by adopting improved tools and technology. It is true that machanization could bring down the cost of forest harvesting operations and increase efficiency as compared to conventional methods and tools. However, it may create some unemployment problems. In developed countries, where labour is scarce and expensive, they have adopted high level technologies like chain saws for felling and logging of trees, tractors, skidders and forwarders for handling and transporting the logs, computerized saw mills, radio-controlled cable cranes and other sophisticated machines. No doubt adoption of such technology assures fuller utilization of felled trees but also results in considerable reduction in employment. In developing countries felling technique gradually advanced from axe to saw and later to improved saw, chain saw and to tree shears. In India axe remained as the main Basic Logging Tool (BLT) for a long time. The first use of saw in Indian Forestry dates back to 1852 in Kerala. Mr. Winkelman from Switzerland introduced some European made BLT to different states in India. During 1977 the Swedish International Development Authority started its support to the Logging Training Centre Project, Dehra Dun (LTCP) and in 1980 LTCP started the tool unit for active BLT development and quality control. Imported power chain saws were introduced during 1960s but these have not been successful because of non availability of spares and problems in maintenance and of course due to cheap labour available (at present the main tools used for felling and crosscutting are axes and cross cut saws). With this experience we have to adopt a technology best suited for our socio-economic conditions. We need a locally 'intermediate' labour-intensive technology for various forest operations, thus giving more importance to the manual labour and improved traditional tools.

C. Mohan
Division of Pathology (Fungal diseases)

Divisional highlights-3

Plant Ecology

For better management of our natural forests a thorough understanding of the ecology is essential and the very fact that studies on the vegetation aspects of the forest ecosystem is of prime importance makes plant ecology a foremost field in forestry research. This complex field of plant ecology mainly includes areas like identification of the various components of the forest flora, determination of the composition of various associations found in forest formations, studies on the plant diversity, phenological patterns and so on so as to bring out detailed information on the forest ecosystem as a whole. Currently the division has six research projects in hand.

Whenever a new forest is opened up for mangement the first problem encountered is identifying the species composition. Leaving apart the reputed timber species which are well known to the foresters, a host of other species, often including common trees are unkonwn and this together with the seedlings pose enormous problems. To overcome these difficulties the division is engaged in preparing a vegetative key for the arborescent species and another key for the the seedlings based on eco-taxonomic features.

Evergreen species differ considerably in flowering and fruiting. It is commonly believed that most of the species flower and fruit during the dry season. But precise data on phenological aspects are lacking and one project dealing with the phenology of evergreen species is well under way.

Species of the tropical forests grow in complex association. Among these the commercial ones constitute only a fraction. For better management and extraction of timber the composition of the forest has to be precisely known.

Since Trichur Forest Division abodes moist evergreen, semi-evergreen and moist deciduous forests a study has been initiated to find out the incidence of various species present. Along with this the relationship between soil and vegetation is also being looked into so that a rational land use policy can be evolved.

The moist evergreen forests of the western ghats are being worked under a silvicultural prescription called as Selection System. Although this method of working has been in vogue for nearly three decades the impact of this system on the ecosystem as a whole has not been studied yet. A project entitled "Impact of Selection felling in a forest ecosystem in Kerala" has been recently sanctioned by the Department of Environment, Government of India and the project aims to evaluate the ecological disturbances that are likely to be caused due to this system.

– Division of Ecology

seminar on eco-development of western ghats

It is proposed to hold a 2-day seminar on eco-development of western ghats at Kerala Forest Research Institute, Peechi on 17th & 18th October, 1984.

FOCUS

A study on the reproductive biology of teak in Nigeria showed that various factors influence flower-insect pollination interaction. The Asian provenances flowered late in Nigeria and were more vigorous in growth than Nigerian provenances. Though an inflorescence produced a large quantity of flowers, the abortion rate was very high (97%). The major insect pollinators of teak were *Euphaedra janalta, Acraea bonasia, Belanois calypso, Nomia tridenta, Megachile cincta, Belanogaster juviceus*, and *Sarcophaga* sp. The activities of these pollinators were high at 0900–1230 hrs and coincided with the peak of nector secreation in flowers. Pollen was viable upto two days after anthesis; stigma was receptive only on the day of anthesis. The study suggests that pollination ecology should be included in any meaningful breeding programme for teak *(Ph.D. Thesis. University of Ibadan, Nigeria, 1981. Summary in For. Abs. 44(10) : 605, 1983)*.

Body and faecal pellet weights of large ungulate (African bovoid) have a highly significant ($P<0.001$) linear relationship. It is suggested that a power curve provides a better estimation of body weight from the random pellet samples ($y = 6.4387 \times 1.1223$) than a linear regression. This method may be employed to establish a mean body weight for a population or individual weights. *(Afr. J. Ecol. 21 : 165-174, 1983)*.

An ion exchange resin bag technique was compared to six other methods for estimating nitrogen availability in forest soils. Under a controlled greenhouse environment with well-mixed soils, the resin technique correlated well with more traditional N-availability indices. However, resin bags on site in three forest stands yielded different N-availability estimates than those in greenhouse. This suggests that the resin bag method may be sensitive to on-site conditions not discerned by more widely accepted laboratory techniques. *(Soil Sci. Soc. Am. J. 47: 1050, 1983)*.

A pollen handling system for controlled breeding of eucalypts involves clipping of anthers from freshly opened flowers, grinding them in distilled water and then passing through a double filtration system. This process leaves the pollen as a deposit on a milipore filter. After drying over silica gel these filters may be cut into strips and stored in glass bottles at-16°C. When required for pollination individual strips may be extracted, used to brush pollen on to stigmas and then discarded. High viability of pollen grains was maintained for one year. Viable seeds collected following pollination with stored pollen grains provided a a definite test of the non-injurious nature of the treatment *(Silvae Genetica 31 : 198-203, 1982)*.

Germination of stored *Albizia procera* seeds can be enhanced by soaking the seeds for 5 sec. in boiling water, immediately removing them from direct heat and then re-soaking them in tap water overnight. Compared to those with no pre-germination treatment or with sulphuric acid treatment, this method gave a two fold germination of seeds. If dried and sealed in plastic bags these seeds can be stored in a refrigerator for 4 to 5 months. *(Silvatrop 6(2): 85-90,1981)*

"Protection and species conservation go very well together; exploitation is in total conflict..."

Dr. Peter Ashton, Director, Arnold Arboretum, Harward University, USA was interviewed on 22 Sept. 1983 by Evergreen. –Ed

• • •

Evergreen: As a taxonomist with vast exposure to tropical ecology would you subscribe to the view that if a particular ecosystem is tampered with all the species associated with it will be obliterated?

P. A: Obliterated? I would not subscribe to that view. Anyway tampering occurs in nature. There are land slips, lightening damage, wind throws, etc. which are all tampering with the nature. In nut-shell, disturbance to forests is a natural phenomenon. What human beings do add to the intensity of tampering; sometimes erratically as when a field is temporarily cleared, sometimes less erratically as in selective felling operations. What happens depends on the kind, degree and extent of tampering. In the tropical rain forests there are many species which are on the one hand with very poor seed dispersal and on the other have very specialised requirements for establishment. There are also many species which grow very slowly. For the species with poor seed dispersal it is difficult to get established, as the conditions created in the field are totally unsuitable for their successful establishment. For slow growing species it takes much longer for them to grow to the first flowering and fruiting. So they will not be able to reproduce themselves. Initially pioneer species create a microenvironment beneath their canopy suitable for the regeneration of many species. It is important to record that when field clearance takes place rather frequently, then the species with the poor dispersal and slow growth will never return and are thus obliterated. Accounting the much less intensive disturbance caused by selective felling, the same grand rule holds true, lest in any kind of disturbance which favour the fast growing species. In these circumstances seed dispersal is probably not a problem if the mother trees survive, but the condition for re-establishment of seedlings often are not prevailing as felling operations, which are unsuitable, remain for considerable time. Therefore, traditionally, silviculturists working with tropical forests have relied on the seedlings already established on the ground prior to felling operations. Seedling survey and enumerations prior to felling operations have been prescribed to ensure that seedlings do exist on the ground. There are two serious drawbacks with this. One is that the seedlings are often patchy or often do not exist. In the latter situation we cannot afford to wait for felling the forest till the seedling appear. So the forests are selectively logged, even when there is no regeneration. The other problem is that with the increased mechanisation the amount of damage done to the regeneration is so great that even if regeneration is there, too much damage is done so that there is an inadequate stock for the new crop. You are using elephants in the ghats, which on the whole is a very good method for extracting timber because it can be managed with

Here the cardinal point is careful management. If the forest department staff are not there to care, you can be sure that the contractor will not care whether he damages the regeneration or not, unless he is given a long term contract, where by he has an investment in the new crop.

minimum damage. Here the cardinal point is careful management. If the forest department staff are not there to care, you can be sure that the contractor will not care whether he damages the regeneration or not, unless he is given a long term contract, where by he has an investment in the new crop. That is a very unusal situation in the tropics. I very much doubt whether you do that here in Kerala.

Evergreen: What is your experience with the various systems of management adopted in the evergreen forests of South East Asia. Are they really capable of regenerating the forest adequately?

P. A.: Natural regeneration mostly depends on two factors; one is the species present in the forest and the other the exploitation damage. Species with rather high growth rates and also species which reproduce sufficiently have good chances for the regeneration. If the land is gently undulating it is rather easy to minimise the exploitation damage. If the land is steep, however, it is extremely difficult in particular to protect erosion caused by road building process. And often the engineers favour building the roads along the ridge tops where the densest stands of high quality timbers are found. So there is a conflict between the needs of silviculturist and the needs of the engineer. I would say that it is possible to regenerate this forest but it requires very careful management. In Kerala you have the disadvantage with many of the species in the wet evergreen forests, the quality species are slow growing. Their regeneration is very patchy and also the land is very steep. So you have got many factors which are unfavourable. There are however species like *Bombax ceiba* which probably are the ones to favour. What is important is that there has to be a very careful and explicit planning policy. For what is expected of individual forests you have to decide, "is this going to be a forest for exploitation", in which case do not attempt to conserve all the species. It is impossible; you cannot do it. Use that for exploitation, make it as productive as possible. There are areas where you have serious problems with soil erosion and water shed management. These areas you have to recognise as protection forests and under no circumstances should they be exploited, because the exploitation is in direct conflict with the protection or conservation needs in those areas. Protection and species conservation go very well together; exploitation is in total conflict.

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Evergreen: Do you think a uniform system like the canopy lifting practised in Andamans and South East Asian countries appropriate for the Western Ghats?

P. A.: Emphatically, no. Because, the existence of regeneration is too unpredictable. In the region where the uniform system works there is rather a high degree of predictability of regeneration, as a rule there is inadequate regeneration. To find adequate regeneration is an exception and that is quite an unsuitable situation for the uniform system. In theory the selection system should be used and should work. Some kind of a shelter wood system where several fellings under a period of over 20 years are undertaken and then forests are left for 60 or 80 years before felling starts again. You cannot continue with small frequent fellings, because the exploitation damage is additive. So very soon the forest begins to deteriorate and becomes incapable of regeneration. I had this experience actually not in the Andamans, but in Combodia and Vietnam, where I myself have undertaken some studies on this difficult problems, and the impression I have is that the economic species do infact flower and fruit every year. But there is a very high incidence of the seed predation by insects, parakeets, squirrels, deers, pigs, etc. At the end there is very little successful seed germination and establishment which happens in the first wet season. And then, the next dry season is critical, for the dry season is a long one or still an average one. Even a few seedlings that were established have not yet formed sufficient deep root system to survive that dry season. So the result is that successful establishment takes place only at long intervals, when there is a combination of exceptionally heavy fruiting, which saturate the predator population followed by unusually wet season allowing survival of seedlings. This happens under natural circumstances. To have an economic forest policy based on such an unpredictable system is clearly quite impractical. I believe the solution is to put much more research into enrichment planting, which at the moment is very unpopular. I think there is a question of the micorrhiza also which is particularly important in the establishment of seedlings. I believe we have

to develop methods which will make enrichment planting economically practical. I would strongly advocate to use species mixtures. Because when you are doing enrichment planting you are cutting a line, and the canopy conditions above that line are very variable. If you want to get maximum production from the forests you need a variety of species to react to the different canopy conditions along the line. Then you can expect a much greater possibility of getting adequate survival of this regeneration. That is another aspect which needs investigation. I tend to be a conservative and feel that it is better to put investment in trial pilot experiments on a variety of conditions to see whether we can come up to something which is cheaper and more reliable. Perhaps we are expecting more from the forests, than the forests are capable of producing. We have to realise that.

Evergreen: Have you so far come across a situation where an evergreen forest is managed successfully on a sustained yield basis ?

P. A. : No. I don't think, I have not seen any rainforest in the world being managed successfully for sustained yield by any method. But I would also say that it has been done successfully in the past, at a time when the machinery used for exploitation was smaller and less harmful to the regeneration and there was less expectation of the quantity of the product. Now we ask too much from the forests.

If you want to get maximum production from the forests youneed a variety of species to react to the different canopy conditions along the line. Then you can expect a much greater possibility of getting adequate survival of this regeneration.

Evergreen: How will you distinguish between the tropical rainforests of Richards with that of tropical wet evergreen forests of Champion ? Do you think both these terminologies have some striking difference?

P. A. : Yes, when one classify vegetation or anything else, we often find it useful to create a hierarchy, broad groups with sub groups within these broad groups. Richard's classified term, the tropical rainforests is a blanket term for any evergreen forest in any frost free climate at any altitude, which is predominantly evergreen. It is a very satisfactory term when one is talking in these broad generalisation. Champion was working with one region, a region including Burma, Bangladesh, India and Pakistan; not Sri Lanka. Interestingly enough his classification actually works also in Sri Lanka and so in Indochina. So within the different major, climatically defined types Champion recognised many sub groups. Sometimes, however, the range of some types of tropical rainforests in the region studied by Champion is of some affinity and one of them is entirely absent. If Champion had merely included Sri Lanka in his classification he would have met this type and recognised it as different from the so called Tropical Wet Evergreen type of the Western Ghats. I don't know what the term should be but it is substantially different and is correlated and found only in those wet tropical climates, which have no months on an average with less than 10 cm. rainfall, in other words, every month on average with more rainfall than evaporation. Now this climate is not existing in India but it exists in Sri Lanka and those forests are exceptionally rich in species and have rather different phenology and reproductive biology from the tropical wet evergreen forests of the Western Ghats. You find different forms of management and therefore I will consider them to be something distinctly separate and necessarily distinct group of forests for strictly ecological reason and also for management reason.

Evergreen: As you know, the dominance of a single species is rather a rare phenomenon in the rain forests. But where it does occur is it related to the soil?

P. A.: Probably I think it is an indicator. But I think one often finds that where a single species is associated with a particular soil condition, the soil condition is not always associated with a single species. The dominance of a species cannot be explained purely in terms of peculiarity of the soil. If you ask me to guess the causes likely to be, I would guess, that the forest in ecological terms is rather young, that is less than 5000 years. The forest is either burned or otherwise seriously disturbed for one reason or other and has not built up a stable equilibrium status with the mixed conopy, and this is just the likely explanation for the soil condition for their dominance. What we find in the far eastern mixed rainforests, is that the forest structure is principally related to soil water relations, topographic factors, floristic composition, etc. which of course on broad generalization is principally related to soil fertility. We are also finding relation between species composition and the level of phosphorus in soil, which is an indicator element. Magnesium also is

particularly correlated to floristic composition. Once the total phosphorus exceeds about 300 ppm floristic variation is no longer detectable. The range between 30 and 75 or 80 ppm is indicative of rather infertile soil. That is where the species richness is highest.

Evergreen: Do you think the terms threatened or endangered species are relevant to conservation when botanical surveys are too incomplete in India?

P. A.: I think they are useful. Because actually you can't underestimate the amount of knowledge that exists in the flora of India. We know about the flora of India than any other tropical nation. And therefore these terms do have value in the Indian context, because it takes so long to make detailed botanical surveys of individual areas and also because endemism, species richness, etc. are tied together very closely to particular habitat

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conditions. Undoubtedly the priorities are to classify habitat types and to identify pristine undisturbed habitats that still exist and which are representatives of the major biogeoseries in India. That is where the priority lies because it is certain that we will loose many species. This is unavoidable. We have to set up priorities, as many as we can. Habitat approach in my opinion has to be the one that takes priority.

Evergreen: In India Dipterocarp forests are ever decreasing. Do you mind suggesting any ameliorative methods for its conservation and improvement?

P. A.: Well, I think this observation is correct. Fifty years ago, the Dipterocarp timbers were among the most valuable timbers. The economic changes and the demand for forest products will continue to change in future as it has happened in the past. So there has to be a balance between plantation forestry, which is producing a particular product needed at the moment and the mixed forest management which ensure the resources which may not be required presently but will be in the future. I believe that in the near future other kinds of timbers would have priority over the Dipterocarps, And therefore Dipterocarps are one of the many different groups of tropical trees which are in need of conservation in adequate areas set aside for research and conser-

We really, all of us have to exercise social responsibility. We all of us have this problem and we all of us have to work because it is too late to think in this regard as you and me or we or them. It is all our fault. It is not the logger or the shifting cultivator alone but it is you and me.

vation. Once something is gone it is gone for ever you can never get it back again. I am not against plantation forestry, I am just saying that the balance has to be achieved.

Evergreen: Whom would you blame the logger or the shifting cultivator for the destruction of the forests?

P. A : The major cause without a shatter of doubt is that there are too many people in the world. If our colleagues in the family planning agencies are not successful, then we all of us will be starving because the world is a finite service with a finite biological productivity and however hard we work, however much fertiliser we use, however much we do plant breeding there is a limit, and we are close to the limit already. We really, all of us have to exercise social responsibility. We all of us have this problem and we all of us have to work because it is too late to think in this regard as you and me or we or them. It is all our fault. It is not the logger or the shifting cultivator alone but it is you and me.

Some Alternative Tools and Improved Techniques in Logging: 3 Extraction

Extraction is the next step in logging operation after felling. It's main components are dragging, stacking, lifting, loading and rolling the logs. In India, the extraction work is commonly performed manually or by using elephants. The forest workers, instead of using appropriate tools, use bare hands for handling the logs. For more productivity and safe working conditions two simple tools are recommended here – (1) Log hooks and tongs and (2) Skidding grapple.

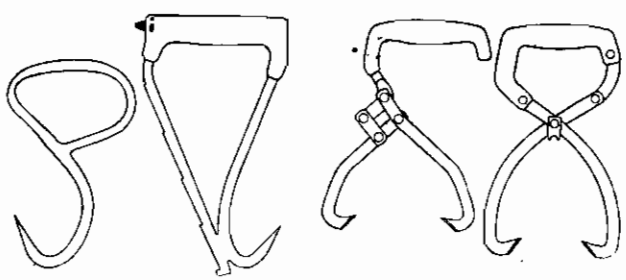
Log hooks:

Two types of log hooks are shown in Fig. 1a (by permission of FISKARS, Finland).
Technical specifications:

	Model No.	*Weight Kg*	*Length mm*	*Width mm*
1.	19000	0.2	210	255
2.	19010	0.4	255	150

Log tongs: Two models are shown in Fig. 1 b.

Model No.	*Weight Kg*	*Length (closed) mm*	*Width mm*	*Maximum grasp width mm*
19060	0.5	290	150	178
19100	0.7	310	155	229



a b

Fig. 1. Log hooks

Advantages of using these tools: Normally in extraction activities the workers use bare hands in handling the logs. That will usually cause more strain and reduce work efficiency. But the use of the tools described here will help in productive straight-back working and reduce the strain in operation. This enables the work to be carried out even at difficult terrains.

Skidding grapple:

Another type of tool used in dragging the logs is skidding grapple (Fig.2). It can be used with animals (elephants) and forest tractors.

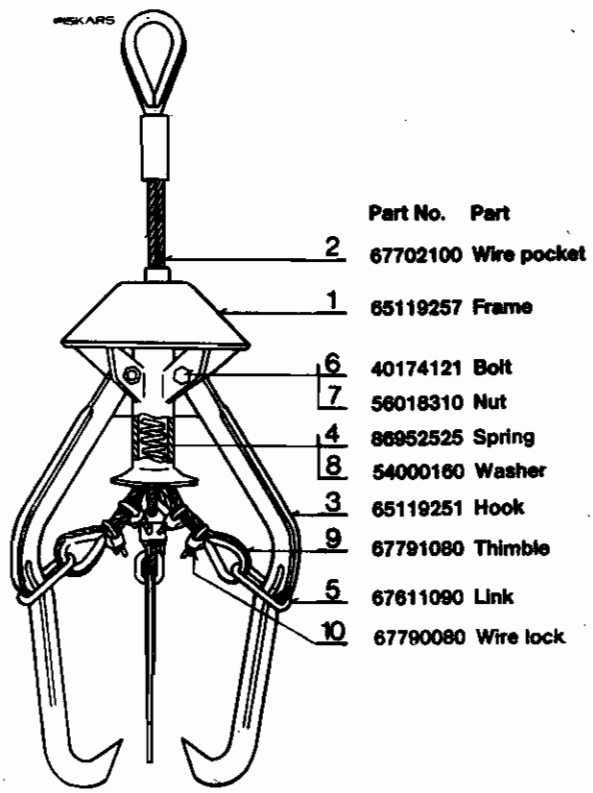


Fig. 2. Skidding Grapple

Technical specifications:

Maximum opening	:	650 mm
Maximum length, including cables	:	775 mm
Maximum width (closed)	:	300 mm
Weight	:	6 Kg
Maximum cable thickness recommended	:	8 mm

Advantages: In usual extraction practices after snouting the logs, drag holes are made at one end for elephant dragging. This practice causes much loss of timber and labour. Use of this grapple eliminates both of these.

Fig. 3. Use a correct lifting technique. Keep your back straight. The strong leg muscles will do the lifting.

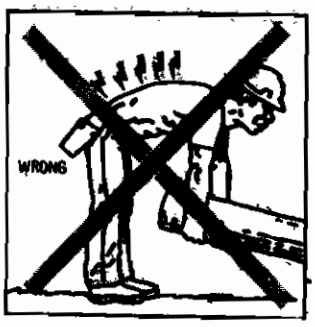


Fig. 4. Never handle the logs with hands nor with back.

Fig. 5. Use a hook and the aid of other logs for rolling.

Fig. 6. Use two hooks and broad grip for carrying, carry with straight back-load on legs.

Fig. 7. Use two hooks for dragging.

Fig. 8. Don't twist the body rather use two hooks.

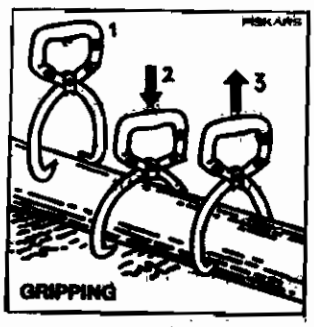


Fig. 9. Tongs; automatic grip. Place on top of a log (1), push (2); pull (hooked) (3).

Fig. 10. Use tongs and leg muscles for lifting.

Fig. 11. Use hook and tongs for stacking.

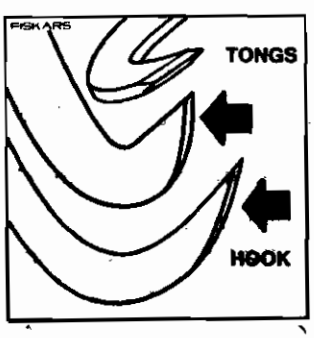


Fig. 12. Sharpening by filling from the outer side only. The original sharpening angle must not be changed. Grease tong hinges.

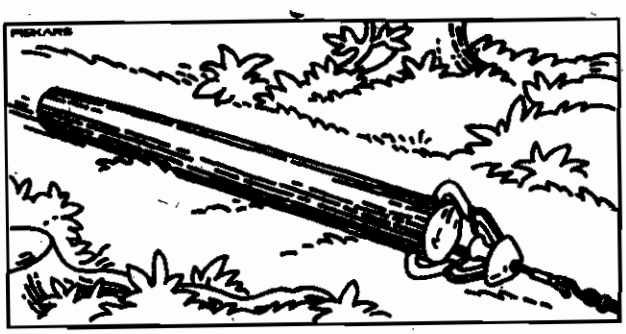


Fig. 13. For skidding with a grapple, either elephants (animals) or machines may be used.

–K. M. Bhat
Division of Wood Science

Dalbergia-Its Diversity and Distribution in Kerala

In the tropical and subtropical belts of the globe, more than 300 species of the genus *Dalbergia* L. f. are distributed. Of them, about 17 are timber species and a dozen or so yield the rosewood. In India, more than 25 species of the genus are found. Among them *D. latifolia* Roxb. and *D. sissoo* Roxb. *ex* DC. are well reputed for their wood. Another little known rosewood species of South India is *D. sissoides* Grah. *ex* Wt. *et* Arn. locally called the *Vel-itti* confined to the Western Ghats of Kerala, Karnataka and Tamil Nadu.

Kerala with 17 species and a variety is the largest known habitat of *Dalbergia* in India. They are distributed right from the peaks and slopes of Western Ghats in the State to the backwater areas where still exists the relics of mangrove vegetation. Apart from the tree forms, a majority of the species are shrubaceous climbers and stragglers and a few are huge lianas reaching 15-20 meters in length, often armed with stout thornes. This habit diversity of the genus is further. exemplified by the presence of a creeper *D. beddomei* Thoth. In their geographical range, Dalbergias of Kerala are South-East Asian, Peninsular Indian endemics or species exhibiting disjunctive distribution pattern with Western Ghats of South India, Eastern India and Malesian countries coming within their range.

Fig. 1 *Dalbergia latifolia* Roxb.

Fig. 2. *Dalbergia sissoides* Grah. *ex* Wt. *et* Arn.

Among the tree species of the genus in Kerala, *D. latifolia* (Fig.1)*D. sissoides* (Fig.2) and *D. sissoo* yield valuable wood. But *D. sissoo* known as Iruvil in Malayalam is a North Indian species known only in introduction here. Being very rare this species does not contribute much to the timber resource of the State. However, *D. latifolia* found more in the interior ghats and *D. sissoides* growing more along the outer fringes of the forests produce the rosewood of commerce. In order to differentiate these two rosewood species, the former is often referred to as the Bombay blackwood and the latter as the Malabar blackwood. *D. melanoxylon* Guill. et Perr., the African blackwood or the Chinese blackwood, is

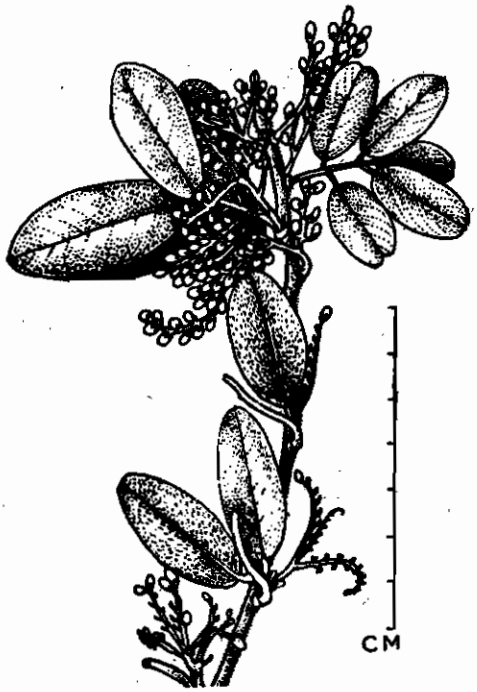


Fig. 3. *Dalbergia beddomei* Thoth

yet another small tree seén in southern Kerala. Its wood is reputed in Europe for making musical instruments and for carving. The other tree Dalbergias of the State are *D. paniculata* Roxb. and *D. lanceolaria* L. f., the former available in Malayattoor, Palghat and Kasaragod forests and the latter almost throughout. They are locally known as *Pannivagai* and *Malamuringa* respectively and are lopped as fodder. The light wood of *D. paniculata* is also used in the making of musical instruments.

D. volubilis Roxb. locally known as *Cherumullu* and *D. multiflora* Heyne ex Prain (with the variety *glabrescens* Prain) are two lianas growing to about 15-20 metres at an age of 15 years. The latter species, the leaves of which are medicinal, is well-known as *Ana-mullu* in Kerala because of the large thornes that it bears. The shrubaceous climbers constitute the largest group in the genus. *D. rostrata* Grah. ex Prain, *D. acaciaefolia* Dalz., *D. malabarica* Prain, *D. travancorica* Thoth., *D. rubiginosa* Roxb. and *D. spinosa* Roxb. come under this category. Of them, *D. acaciaefolia* and *D. malabarica* are endemic to Southern Peninsular India; the former known in Kerala from the Wyanad forests and the latter from Quilon. *D. rostrata* collected from Paruthippally in Trivandrum district and from Thirunelveli in Tamil Nadu is yet another interesting species as it is found nowhere else in India, but is common in Borneo, Celebes, Malaysia and also Srilanka. *D. spinosa*, the roots of which are medicinal with anti-alcoholic properties, and *D. travancorica* are two other climbers whose exact localities of distribution within the State is yet to be ascertained. Again *D. rubiginosa*, Aneivalen valli, found in the forests bordering Chandragiri river at Kasaragod and in Kottur forests of Trivandrum district is also a rare climber.

Silent Valley abodes an endemic *Dalbergia* namely *D. beddomei* Thoth. which (Fig 3) is a creeper on the forest floor. The ecological amplitude of the genus is further evident by the presence of a mangrove-associate, *D. torta* Grah. *ex* Gray (Fig. 4) growing along the banks of Ashtamudi lake at Quilon and also in the coastal areas of Alleppey. This species climbs on *Rhizophora* trees often completely covering it and seedlings of it may be seen sprouting in the brackish sandy-silt soaked by the waves. This straggler with a south-east Asian range is also common in the well-known mangrove formations of Sunderbans in W. Bengal.

Thus the genus *Dalbergia* in Kerala exhibits much diversity in its habit and habitat and the various species found are well–adapted to the varied climatic and edaphic conditions prevailing in the State. Over exploitation and conversion of the natural forests into plantation have already contributed much to the reduction of the natural populations of not only those rare and endemic species but also the timber yielding ones which were earlier abundant in our forests. Hence the need of the hour is to raise an *ex situ* live collection of the genus in the State so as to preserve its genetic diversity for the future. An attempt is being made in the Kerala Forest Research Institute to establish a germplasm bank of the genus helping to conserve this valuable natural heritage.

Fig. 4. *Dalbergia torta* Grah *ex* Gray

—K. K. N. Nair, Division of Botany (Taxonomy)

Utilization of Coconut Wood

Coconut palm belongs to the family Palmae. It is mainly distributed in the tropical coastal regions. In India, an estimated 10 million people depend directly or indirectly on coconut culture and processing as a source of income, employment and interstate trade. Kerala State accounts for about 70 per cent coconut area in the country and out of estimated 161 million palms, about 104 million palms are bearing and the rest non-bearing. Coconuts which are above 50 years constitute approximately 5.3 percent.[1]

The coconut is a unique subsistence crop because of its wide range of products and its ability to thrive under many adverse conditions like high pH and salinity. The trunk attains a considerable height, 20 m or more, depending upon variety, age and environment. As coconut palms do not increase in diameter with age, it is uncommon to find a stem over about 30 cm diameter. When cross-cut, three distinct zones can be observed: dark brown fibrous tissue resembling bark, high density outer portion and a low density core. The density reduces with height of the stem and from periphery to core. Coconut 'wood' is a fascinating material with widely varying properties but highly predictable relationship between different properties.

In Kerala, the stems cut down for reasons such as senility or clearing area for house building are normally used as beams in low-cost house building, country bridges, as fuel wood in brick kilns, etc. Systematic cutting of senile palms and palms damaged by pest or disease (like root wilt) and removing them from the land has become a necessity because of economic consideration and phytosanitary precaution. If massive replanting programme is taken up in Kerala to replace senile and wilt-diseased palms, large quantity of coconut 'wood' will become available. It is highly desirable to investigate and develop possible use of coconut 'wood' which will help in reducing the pressure on the forests.

Though the stem of coconut palm can be referred to as 'wood', it differs in many respects from conventional wood. Differences between conventional wood from conifers or hardwood trees and wood from cocount stems can be listed as follows[2].

	Conventional wood	Coconut 'wood'
1.	Trees have secondary thickening. So the diameter of the stem increases with age. Variations in growth rate during the year may produce annual rings.	No secondary thickening, no increase in diameter, no annual rings.
2.	The elongated cells that give strength to the wood (fibres or tracheids) are distributed uniformly and continuously throughout the stem.	Fibres are grouped together in distinct and isolated vascular bundles and fibre bundles.
3.	Most trees produce heartwood in the centre as they grow older and larger.	No heartwood.
4.	Remains of branches within the wood form knots.	No branches, no knots.
5.	Bark is completely separated from the wood by other tissues and is relatively easily removed.	Bark is not demarcated from the wood and is very difficult to remove.

A seminar on 'Coconut stem utilization' was held in 1976 in the Kingdom of Tonga, a Pacific island, with the objectives of bringing together all the available knowledge on the subject and identifying areas where further research and information was required. Another seminar held in 1979 in Philippines looked into the applied aspects of coconut wood utilization. Proceedings of these two seminars provide useful background information. Some of the salient observations/findings are mentioned below.

Sawmilling

The very hard, thick-walled sclerenchyma fibres, and the silica content, soon blunt conventional steel saws. Green coconut wood is more easily cut than that with low moisture content. There is no evidence of any internal stresses in the stem.

Drying

The drying characteristics of coconut wood are similar to those of medium density hardwoods but trouble from collapse is likely with the core wood. Radial and tangential shrinkage are approximately equal and less than 3 percent in drying to 12 percent m. c. except in pieces of low density. As the basic density of the material decreases below about 350 kg/m^3 there is a sharp increase in the tendency to collapse. Surface checking may occur in high density wood if it is dried too quickly.

Preservation

There is no doubt that coconut wood will rot in short time if left in contact with the ground or exposed to the weather. For these uses preservation is essential. Debarking round poles and posts is an extremely difficult task but it is necessary if they are to be treated by conventional pressure methods.

Strength properties

The high density wood of the coconut stem is extremely strong and does not suffer from degrading defects such as knots. On the other hand, the low density wood is extremely weak. A separation of the two is essential if the material is to be used on a designed structure. However, because the strength of coconut timber is highly correlated with its position within the stem, its density and its stiffness, any one of these factors can be used as a basis for sorting the timber into different strength classes. The first 6 m of the stem from the butt may be wholly converted as sawn timber and the remainder be used for poles, posts or for some other purpose. Coconut stems are potentially useful as natural round members because the strongest wood is in the outside of the stem.

Fuel

Coconut wood has a reasonably high calorific value and there are distinct possibilities for converting it to charcoal and activated charcoal.

Machining and sawn timber uses

Compared with conventional furniture timbers, coconut has less desirable working properties. Machining problems could be eased to some extent by undertaking as much of the machining as possible in the green condition. Selected coconut wood from the peripheral portions of the butt log has potential for furniture and other decorative end uses. Solid wood panels, cladding, framing and other construction uses are also possible.

Practically no work has been carried out in India on the utilization aspect of coconut wood. Techniques suitable to local conditions need to be worked out for the efficient utilization of the material. The Division of Wood Science proposes to work on some aspects of coconut stem utilization.

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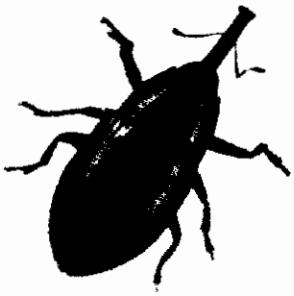
1. State Bureau of Economics and Statistics 1977–'78.
2. McQuire, A. J. 1980. Anatomical and morphological features of the coconut palm stem in relation to its utilisation as an alternative wood source. Proceedings 'Coconut wood–1979', pp. 24-28.

–Division of Wood Science

An Insect Pollinator Boosts Fruit Setting in Oil Palm



Elaeidobius kamerunicus

Elaeis guineensis, the oil palm, is a native of West Africa. Extensive plantations of this species have been established in several parts of the world notably in the S. E. Asian countries. In Kerala, large-scale commercial plantations of this species have been raised recently by the Oil Palm (India) Ltd. and about 3000 ha have been planted during 1980-81 at Yeroor.

E. guineensis is monoecious, with the male and female flowers borne on separate inflorescence and cross pollination is customary. Until recently, it was believed that pollination is anemophilous. In places outside Africa, wherever oil palms have been introduced, the fruit setting is low and assisted pollination is necessary for ensuring satisfactory fruit setting. This low rate of fruit production in recently established plantations outside Africa prompted the Commonwealth Institute of Biological Control (CIBC) to take up studies on the insects that may enhance pollination.

Studies conducted in Cameround (W. Africa) by Syed (1977) of the CIBC have revealed that pollination is greatly enhanced by the insects that visit the inflorescence. Of the several species collected by him, beetles belonging to the genus *Elaeidobius* were found to be the most efficient pollinators.

The *Elaeidobius* beetles are attracted to the male flowers by scent only during anthesis when the pollen grains are ready to be liberated. While probing on the flowers, they get dusted with pollen. Later when the stigmas become receptive, the female flowers also emit a deep penetrating odour attracting these beetles away from the male flowers. On reaching the female flowers they wander about and in this process the stigmas receive the pollen adhering to the insect's body. Since the female flowers do not offer suitable food or oviposition site, the beetles soon return to the male flowers and ovipoist in them. The developing grubs feed on its edible parts. Since the oviposition takes place much after anthesis it does not cause any set back in pollen production. It has been estimated that approximately 5000 beetles visit a single inflorescence thus guaranteeing a high rate of pollination.

While studying the pollinators associated with oil palms in Malaysia Syed noted that *Elaeidobius* beetles were not present in that country. The low rate of fruit setting was therefore attributed to the absence of efficient pollinators. Of the several species of *Elaeidobius* screened, *E. kamerunicus* was found to be the most promising pollinatior for the Malaysian conditions. These were liberated in two plantations in February, 1981. Within a year of release, in the absence of natural enemies in the new habitat, they established themselves quickly in oil palm plantations and spread throughout the peninsula. After the introduction of this pollinating beetle there was about 20% increase in the rate of fruit-setting, which now compares well with the levels found in Africa. Consequent to this there was an increase in the palm oil production and it is stated that the factories had to be redesigned to meet the new situation. Because of insect pollination there was no need for assisted pollination by manual means and a considerable amount of money could be saved. After the successful introduction of this insect in Malaysia, they were also released in Papua New Guinea, Soloman islands, Sumatra and Thailand with success. It appears feasible to boost the productivity of oil palm also in Kerala by appropriate management of insect pollinators, including introduction of suitable species if necessary.

SYED, R. A. (1979) Studies on oil palm pollination by insects. *Bull. ent. Res 69*, 213-224.

—**George Mathew**
Division of Entomology

KENAF - a promising raw material for newsprint

In the wake of denuding supply of raw materials like bamboos, reeds, soft and hard woods, agricultural wastes, bagasse, etc. for the pulp and paper industry, eucalypts have turned to be the major source. Even this fast growing species takes 8 to 10 years to yield. Do we have any substitute? Kenaf *(Hibiscus cannabinus)* is an answer. It is an annual fibre plant which can be an economical substitute to the conventional raw materials for newsprint in India. It is a slender, annual, erect herb belonging to the family Malvaceae and is propagated by seed. This plant, possibly indigenous to India, is cultivated mainly as a fibre crop in the drier tracts of Deccan plateau. More than 3 lakh ha. are under cultivation. It thrives well in well-drained neutral, sandy-loam soil, containing considerable quantity of humus. Medium-black soil in Deccan plateau, alluvial soil of N. Gujarat and the red loam and laterite soils of S. India are all well suited for its cultivation.

Kenaf can produce good quality pulp for newsprint. Pulping tests have shown that it can be readily cooked with 15% caustic soda solution yielding 83.4% pulp, which can be easily bleached (Lathrop & Nelson, Indian Pulp Pap., 1954-55, 9, 27). It may be blended with pulp from short fibred hardwoods to obtain high tearing strength. The test rolls of 100% Kenaf newsprint made by US Department of Agriculture show that it can compete well with the other wood pulp newsprint. Kenaf can also be raised as an under crop in our forest plantations. It needs only very little care and can be harvested 4–5 months after sowing. By intensive cultivation with proper management Kenaf can be an economical substitute for wood pulp in the manufacture of newsprint.

-C. Mohan
Division of Pathology (Fungal Diseases)

Gregarious flowering of thorny bamboo in Kerala

During the summer months (March - May) of 1983 mass flowering of the common thorny bamboo, *Bambusa arundinacea* (Retz.) Willd. was observed at Peechi, Nelliampathy and Parambikulam. The natural flowering cycle of this monocarpic species ranges from 30 to 45 years. It is considered that mass flowering of bamboo is generally associated with severe drought, as it so happened during last year. The flowering has resulted in large scale death of bamboo clumps, creating a shortage of important raw material for pulp industries. People who live in and around these bamboo growing areas took full advantage of this mass flowering in utilizing their seeds as one of the sources of food material.

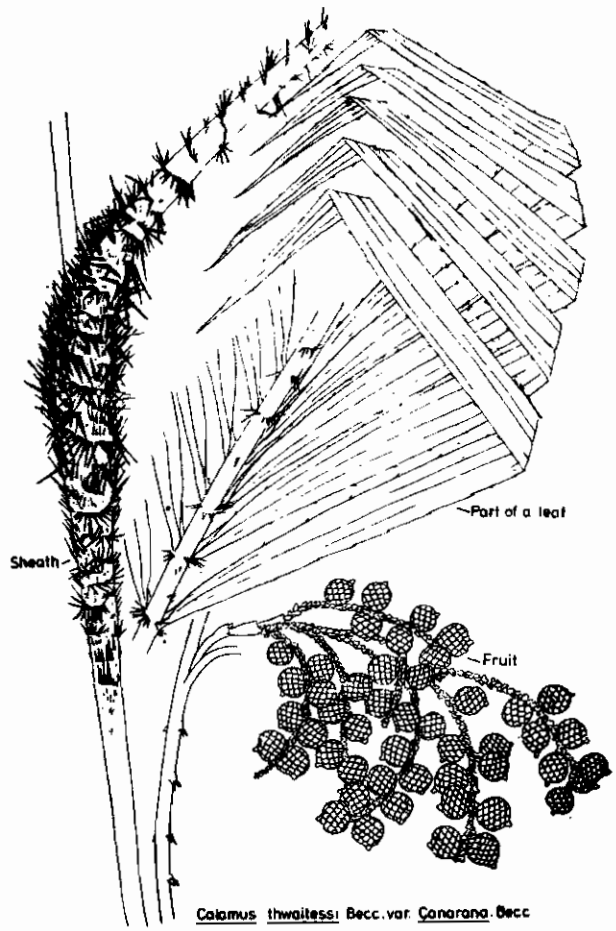
—T. Surendran
Division of Plant Physiology

Calamus - a minor forest produce of promise

Cane is a spiny climbing palm belonging to the Lepidocaryoideae in the family Arecaceae (Palmae). The plants belonging to this group are commonly called as the 'rattans'. The word rattan is an anglicized version of the Malay word 'rotan' which in turn comes from the Malay word 'raut' meaning, to pare, smoothen or whittle. It refers to what a rattan collector does, twist the newly dragged-down cane around any convenient rough barked tree trunk to rub off the prickly leaf sheaths.

There are 12 recognized genera of rattans. They are *Myrialepis, Plectocomia, Plectocomiopsis, Daemonorops, Ceratolobus, Calamus, Korthalsia, Bejuadia, Oncocalamus, Ancistrophyllum, Eremospatha* and *Calospatha*. In India rattans are represented by *Plectocomia, Plectocomiopsis, Calamus, Daemonorops*, and *Korthalsia* of which only *Calamus* occurs in Kerala. *Calamus*, the largest of all the palm genera, is restricted to the orient. There are a total of about 370 spp. of which 53 occur in India and 9 (*C. thwaitesii* Becc. var *canarana* Becc., *C. travancoricus* Bedd., *C. brandisii* Becc., *C. rheedii* Griff., *C. pseudotenuis* Becc., *C. gamblii* Becc., *C rotang* Linn., *C. hookerianus* Becc. and *C. huegelianus* Mart.) are reported from Kerala. They are usually found in the moist deciduous, semievergreen and evergreen forests of Western Ghats.

Calamus is a solitary or clustered, acaulescent *(C. minutus)* to high climbing palm *(C. albus)* upto 120 m. The diameter of the cane also varies widely, 0.2 mm in *C. travancoricus* to 3 cm in *C. thwaitesii*. The stem is completely covered with spiny leaf sheaths. The leaf is perhaps the most important part of this plant from a field taxonomic point of view. Spines on the sheath are so characteristically arranged that even the sterile specimens of *Calamus* can be identified upto species level with it. At the mouth of the leaf sheath there is sometimes an erect ligule like structure extending beyond the point of origin of the petiole. This is termed the 'ocrea'. In some species the leaf sheath bears a large swelling at the base of the petiole called 'knee'. Two specialized and quite different organs are associated with the climbing habit of *Calamus*, a spiny extension of the leaf rachis beyond the leaflets called 'cirrus' and a whip originating from the top of the leaf sheath obliquely opposite to the petiole known as 'flagellum'. Both these organs are provided with whorls of reflexed spines. Of all the rattans, flagellum is found only in the genus *Calamus*. The male and female inflorescences are superficially similar, often extending in a long flagellum. Flowers are small, dioecious, usually in distichous, often scorpioid spikelets; solitary or binate (in female inflorescence, one female and one sterile male flower seen together) in the axils of bracteoles. Fruits are usually ovoid.



Calamus thwaitesii Becc. var. Canarana Becc

Normally rattans mature in about 10-15 years. Harvesting essentially consists of dragging the rattan out of the supporting trees, removal of leaf sheaths, discarding the uppermost 2-3 metres which are soft and hence not useful. The collection of rattan is at all times an unpleasant task. The long flagella and cirri are a constant source of irritation to the collector. The removal of leaf sheaths is a skillful job.

Cane products are innumerable and they are said to be 'fashion proof'. The rattan industry is labour-intensive, with a per worker investment far below than most of the other iudustries, Canes are used for all types of cordage, used whole and split for a vast range of basketware, matting, furniture, fish traps, hats, hawsers for bridge, tool handles, walking-sticks, etc. It still remains the preferred tool for inflicting punishment. Rattan leaves are used for various purposes. In Bali, petiole of *C. burckianus* is used as an elegant coconut grater [1]. Cirri can be used as a fish trap with the reflexed spines preventing fish from retreating. The fruits are edible. The shoot apex of most species of canes is also palatable. To top it all, *Calamus* has medicinal values. They are used to treat rheumatism, asthma, diarrhoea and intestinal disorders [2, 3]. The tribals use the juice from the ripe fruit and stem as a contraceptive [4].

Eventhough, canes are still found growing naturally in Kerala forests, they are restricted to less accessible areas. Until very recently cane has been one of the neglected natural resources and in Kerala it is regarded as a minor forest produce. In India little has been done to establish indigenous rattan plantations on a commercial scale. In the past, cultivation of canes were considered very difficult. The only one reportedly successful commercial plantation of rattan in the world is at Kalimantan, Indonesia. But now cultivation trials done in Malaysia have proved that canes can be successfully propagated by artificial means.

Canes have recently gained greater popularity for they seem to blend with or complement many other modern utility materials. The cane industry has a significant role in the socio-economic development as it provides ample opportunities for employment among rural people.

1. Dransfield, J. 1979. A manual of the rattans of the Malay peninsula, Forest Department, Ministry of Primary Industries, Malaysia. p. 27

2. Chopra, R N., Chopra, J. C. and Varma, B. S. 1956. Glossary of Indian Medicinal Plants, C. S. I. R., India. p, 44.

3. Kirtikar K. R. and Basu, B. D. 1935. Indian medicinal plants. Vol. 4, pp. 2587-2589 Periodical experts, Delhi.

4. KFRI, 1980. Studies on the 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. Kerala Forest Res. Inst. Reaearch Report No. 5, p. 119.

– **C. Renuka**
Division of Botany (Taxonomy)

Oldest teak plantation!

"It appears incidentally that the Nilambur plantation dates from the 1840's, whereas teak was planted in Java in the 1820's".

–Mr. W. Finlayson,
Director, Commonwealth Forestry Bureau, U. K.

Albizia Bagworm Spreads to Gulmohar in Kerala

One species of bagworm, *Pteroma plagiophleps* Hempson (Psychidae, Lepidoptera) was found to cause damage to plantations of *Albizia falcataria* at Vazhachal, about 40 Km east of Chalakudy in Trichur district, for the first time in April 1977. Since then it has been causing sporadic defoliation in the same plantation Although it spread to a nearby *Albizia* plantation it has not been noticed in plantations of this tree in other areas. Older larvae also feed on the outer bark of the branches and main stem. In affected areas thousands of pupae can be seen hanging on the branches. Bagworm feeding causes defoliation of the tree as the damaged leaves wither and fall off. Severe defoliation often causes drying up of the upper portions of the tree.

Although the gulmohar, *Delonix regia*, was found to be free of infestation for almost 2½ years since the bagworm was first noticed in *Albizia*, an infestation has been building up on *Delonix* trees planted along the roadside for the past few years. Infestation of *Delonix* was first observed in October 1979 at Pudukkad, 20 km south of Trichur; but now it has spread on roadside trees throughout Kerala.

As gulmohar trees are planted extensively along the national highways, in addition to wind dispersal the larvae which descend down on silk threads (older larvae also descend on threads when the populations are crowded) often get on to vehicles and are easily transported to other areas. Some mature larvae which habitually descend from trees and pupate on any suitable surface may often get lodged on parked vehicles and aid dispersal of the insect.

Bagworms are insects that live within bags made by them. If the bags are removed, they look like ordinary caterpillars. They feed on leaves and sometimes on bark. The adult stage is a moth. In most bagworms only the adult male is winged. The adult female is worm-like and never comes out of the bag.

Fig. 1. Pupal stage of the bagworm can be found hanging on the branches of affected trees in large numbers.

Fig 2 Male moth of the *Albizia* bagworm, *Pteroma plagiophleps*.

The male moth, after emergence from the pupal bag, searches out the female pupal bags and mates with the maggot-like female by inserting the abdomen through the open lower end of the bag The female then lays eggs within the bag and dies. Later, the new larvae hatch out from the bag and hang down from the branches of trees on silken threads. They are blown over by wind and dispersed to adjacent branches and trees.

The *Albizia* bagworm, *Pteroma plagiophleps* was first noticed in India in 1940 on tamarind tree in which it continues to be a sporadic pest causing limited extent of defoliation, mostly confined to a

few branches of some trees. In *Albizia* and *Delonix* on the other hand, large populations of the insect are built up. Bagworms are generally polyphagous, i. e. they feed on many different plant species. The

Fig. 3 Lower branches of a roadside Gulmohar tree defoliated due to bagworm attack, In course of time all branches may be affected resulting in total defoliation.

Albizia bagworm has also been found to feed occasionally on *Tectona grandis*, *Syzygium* spp. *Phyllanthus emblica* and *Trema orientalis*. They appear to evolve types to adapt to different hosts.

Over a dozen species of bagworms have been found in Kerala, of which some are likely to become serious pests. The most threatening among them is *Metisa plana* which is now prevalent on *Terminalia catappa* planted along the roadsides. This is one of the three species found to cause serious damage to oil palm plantations in Malaysia and is likely to become a pest in the expanding oil palm plantations

Fig. 4. The bagworm caterpillars feeding on the trunk of *Albizia falcataria*. Protected by a conical bag, the insects resemble small thorns.

of Kerala. Another potentially dangerous bagworm found in Kerala is *Manatha albipes* on coconut palm.

– Division of Entomology

When you have any insect problems in your forest nurseries or plantations

Please contact

The Entomologist,
Kerala Forest Research Institute
Peechi, 680653, Kerala

Books of Interest

ADVANCES IN FOREST GENETICS: Edited by P. K. Khosla, Published by Ambika publications, New Delhi, India: 1981. 375 pp. Price Rs.200/-

This book was published to commemorate the pioneering work of Dr. S. Kedharnath in forest genetics and tree improvement in India at the time of his retirement from his active service at FRI and colleges, Dehra Dun. It contains 20 articles on different aspects of forest genetics contributed by 27 authors from Asia, Europe and America.

It is divided into six sections - background, seed orchards, introduction/provenance trials, tree cytology and mutation breeding, tree biology and inheritance and bicohemical basis.

In the first section two articles by Toda and Zobel give a good picture of the past and present roles of genetics and tree improvement in forestry. This is followed by four papers by Van Buijtenen, Venkatesh, Keiding and Bonner on planning and management of seed orchards and certification of seeds. In the next section a paper by Sahni covers interesting topics like pollution, recreation, tourism, nitrogen fixation, etc which are not generally considered in tree breeding programmes. An article by Wright explains the role of provenance testing in tree improvement. The fourth section on tree biology contains five papers covering topics on anatomy, floral characteristics together with pollen properties. The last section on inheritance and biochemical aspects includes four papers covering topics like inheritance of monoterpenes composition, isoenzymes, nucleic acid techniques and genetic response to pollution.

This book, first of its kind published from India, gives a clear picture of forest genetics as it is today filling a gap in the knowledge of recent trends in research. However areas like tissue culture, statistical designs and analyses in progeny testing, vegetative propagation, etc., which are of current importance are not well covered up.

This book will be of immense value not only to students of forestry in general and forest genetics in particular but also to the practising foresters and researchers.

— **Mathew P. Koshy**
Division of Genetics

Recent publications

Published in journals

Gnanaharan, R. 1982. *A simplified boron diffusion treatment for rubber wood. The international journal of wood preservation 2 (4) : 169-172*

Susceptibility of rubber wood to fungal and insect attack limits its wider utilisation. Rubber wood is very permeable and it does not pose any problem for diffusion of chemicals into the wood. This study found that immersing 25 mm thick material in a 10% boric acid equivalent solution containing 0.5% sodium pentachlorophenoxide for 40 minutes gave adequate loading of chemicals even at ambient temperature of about 30°C. It was found that increasing the immersion time does not increase the loading of chemicals appreciably.

Chacko, K. C. 1983. *Polyurethane foam sheet as a substratum for germination tests. Indian Journal of Forestry, Vol. 6 (4) : 325.*

Polyurethane foam sheet is successfully used as a substratum for germination of seeds of *E. tereticornis, E. grandis* and *Anthocephalus chinensis.* Seven to ten days old seedlings grown on foam sheet could be successfully pricked out and potted. Seedlings thus potted registered satisfactory growth.

Sasidharan, N. and Nambiar. V. P. K. 1983. *Hedyotis pinifolia Wall. ex G. Don (Rubiaceae), a new record for South India. Indian Journal of Forestry, 6 (3): 234.*

Hedyotis pinifolia Wall, ex G. Don, occurs in the northern states of India where it is frequent in Sal forests. The recent collection of this plant from Kerala State is a new record for South India. A description with photograph of the specimen is provided to facilitate easy identification.

Surendran, T., Venkatesh, C. S., and Seethalakshmi, K. 1983. *Vegetative propagation of the thorny bamboo, Bambusa arundinaceae (Ret.) Wild. using some growth regulators. Journal of Tree Science Vol. 2 (1+2) : 10-15.*

The internodal cavity in two-noded culm cuttings of the thorny bamboo, *Bambusa arundinacea,* was filled with measured quantities of different chemical solutions and planted horizontally. Treatments with caumarin, naphthalene acetic acid (NAA) and boric acid gave better sprouting and rooting response

than other treatments including control. The study indicates that the success rate of rooting and field establishment of culm cuttings can not only be increased, but the time of propagation can also be widened with the application of suitable growth regulators.

Sharma, J. K., Mohanan, C. and Maria Florence, E. J. 1983. *A little leaf disease of Eucalyptus in Kerala, India. Eur. J. For Path. 13: 385-388.*

A little leaf disease of *Eucalyptus tereticornis, E. grandis* and *E. globulus* characterized by stunting of plants, considerable reduction in size of leaves and internodes, was recorded during survey of nurseries and plantations in Kerala State. The survey indicated that though the little leaf disease was widespread, its incidence was quite low. Transmission of symptoms by sap and graft techniques was unsuccessful. However, positive flourescence and staining of phloem tissues by Dienes' stain indicate that the disease may be caused by mycoplasma like orgainsms (MLO).

KFRI Research Reports

Alexander, T. G., Mary, M. V., Thomas, P. and Balagopalan, M. *Influence of site factors in Bombax plantations. KFRI Research Report No. 17. Final Report of the project Soils 04/1979, September, 1983, 19 pp.*

As noted in Working Plan Reports, *Bombax ceiba* L. (Bombax) does not attain sufficient height by the rotation age of 25 years in many plantations. The slow height growth may be due to climatic, physiographic, biotic and soil factors which constitute the enviroment (site) of tree stand. The present project was taken up to ascertain whether stunting is due to site factors, especially soil.

Literature is scanty regarding investigations on infuence of site factors in *Bombax* plantations. One hundred and sixty-three subsites of 20 x 20 m were marked in 71 plantations from southern, central and northern regions of Kerala for assaying site and tree parameters. One soil sample was taken from 0–20 cm depth in each of the 163 subsites and five dominant trees around the soil sample were selected for top height and girth measurements. The soil samples were analysed for gravel, sand, silt and clay separates, pH, organic carbon, exchange acidity and exchangeable bases.

Elevation of plantations varies from 25-850 m with most falling in the 25-150 m range. Majority of the subsites are well drained and all have good undergrowth. While 13 subsites have pure stands, others are mixed either with teak or *Ailanthus*. Correlation coefficient for dbh vs height is 0.87 (n+163) which indicates that the linear growth is not spindly. The correlation coefficients for height vs age and dbh vs age are poor (0.38 and 0.40) suggesting suppression of height and diameter growth. For comparative purposes, height data were transformed to 25 years and the midpoint between maximum and minimum height was taken as the cut-off height (15 m) to differentiate stunted and nonstunted stands. Height varies from 6.7 to 21.3 m and it declines towards north. Mean differences of soil parameters in stunted and nonstunted plantations are significant for all except sand and organic carbon in southern region, nonsignificant for all parameters in central region and nonsignificant for all except gravel and organic carbon in northern region.

Though the monsoonal climate in Kerala is congenial to *Bombax*, current study reveals that plantations in central and northern regions do not gain as much height as those in southern region. Stunted and nonstunted stands occur contiguously on subsites with similar physiographic features and above 750 m elevation height growth is slow. Teak mixing with *Bombax* does not seem to have any effect on *Bombax* height while *Ailanthus* mixing may have an influence. *Bombax* comes up well in the sandy loam soils of southern but not central region, while stunted plantations of northern region have more silt+clay. The inconsistent trends of mean differences for soil parameters in stunted and nonstunted plantations suggest no clear-cut relationships between tree hight and various soil parameters. The feasibility of planting *Bombax* in central and northern regions where it does not reach sufficent height needs appraisal.

Nair, C. T. S. and Muraleedharan, B. K. *Rural institutions for development of appropriate forestry enterprises: A case study of the traditional reed industry in Kerala State, India. KFRI Research Report No. 18 Final Report of the project, Econ 03/82, 1983, 150 pp.*

This case study was done with the objective of generating information regarding the role of selected rural institutions in undertaking and promoting forestry activities. Although a minor forest product, bamboo reeds (*Ochlandra* spp.) form an important raw material for both traditional and modern indust-

ries in Kerala. Mat-weaving and basket-making are the major traditional uses of reeds. For a large number of households reed–based industries form an important source of livelihood. Institutions such as co-operative societies and the state–owned Bamboo Corporation were set up with the social objective of enhancing the income accruing to traditional workers by eliminating intermediaries. Production of baskets and mats requires little capital input and is appropriate to the resource endowments of household producers. Financial and economic viability and social desirability of the activities and institutions have been examined. Internal organisation of the institutions involved in the collection, processing and marketing of reeds have been studied focusing attention on workers' involvement in decision-making. The Bamboo Corporation is characterized by a vertical structure providing little scope for workers' participation. Even in the case of co-operative societies the involvement of workers in decision-making is limited. Performance of the institutions under these conditions becomes primarily dependent on the commitment and ability of the leadership. How an institution interacts with other institution is also an important factor. Social, economic and cultural characteristics of reed workers have been briefly discussed. An analysis of the interaction between society, institutions and technology indicates that reliance on market signals for decision–making would, in due course, compel institutions to deviate from their initial objectives and a tendency towards adoption of inappropriate technologies develops. This study indicates the conditions that favour the development of appropriate institutions and suggests measures for enhancing their effectiveness under the social environment that prevail in the state.

Nair, K. S. S., Mathew, George and Varma, R. V. *Preliminary investigations on the biology and control of beetles damaging stored reed. KFRI Research Report No 19. Final Report of the Project Entom 04/79, August 1983, 33 pp.*

The damage potential of *Dinoderus* beetles (Bostrychidae) to stored bamboo reed, *Ochlandra travancorica*, one of the fibrous raw materials for paper pulp, and possible method for their control were investigated. The study included a general survey of insect damage of stored reed in Kerala, development of methods for rearing *Dinoderus* in the laboratory, experimental investigations on factors influencing susceptibility of reed to *Dinoderus*, and evaluation of several chemicals under laboratory as well as field conditions for control of the borers. Observations were also made, incidentally, of fungal damage to stored reed.

Dinoderus spp. were the most important beetles damaging stored reed, although a few other species, viz., *Heterobostrychus aequalis* (Bostrychidae), *Minthea rugicollis* (Lyctidae) and *Myocalandra exarat* (Curculionidae), were also found on reed. Two species of *Dinoderus* were involved- *D. minutus* Fabr. and *D. ocellaris* Steph.; the former was the most frequent and widespread, occurring also on manufactured reed articles. *D. ocellaris* was found in a mixed population with *D. minutus*. Subterranean termites were also found to cause damage.

The incidence of *Dinoderus* attack was highly unpredictable. No infestation occured in small bundles of 1-to 2-yr-old reed culms harvested at monthly intervals over an year and stored outdoors in the KFRI Campus at Peechi. In the KNP reed storage yard at Mavelloor and in some other places, active infestation was noticed on several occasions, but not consistently. No distinct seasonal pattern of infestation was evident during the period of study.

Both species of *Dinoderus* could be reared successfully in the laboratory on dried tapioca chips, a new diet developed during this study. Continuous generations could be maintained on tapioca chips throughout the year and the insects required for experiments could be collected with ease. *D. minutus* population increased upto 10-fold during a period of two months, a period sufficient for completion of one generation. Other suitable diets containing wheat flour were also developed.

Experiments revealed that varietal differences, harvesting season and water transportation of reed did not influence susceptibility, but age of the culm at harvest and extent of drying after harvesting, did. Fully mature culm, about 5-yr-old was the most susceptible, while culm of flowered reed was immune. Culms of other ages were susceptible to varying degree, depending on the species of *Dinoderus*. The results suggested that while a threshold concentration of starch may be essential for development of the insect, other factors, possibly nonnutritive volatile chemicals, may elicit or promote infestation. Since reed harvested for pulping consists of an assorted group of culms of different ages, erratic occurrence of infestation may be expected.

Out of 11 insecticides tested by direct application to the beetles, all except three organochlorines —DDT, aldrin and chlordane—were effective. When five of these selected insecticides were screened by application to food surface, only HCH (BHC) and the synthetic pyrethroids, cypermethrin and permethrin, proved effective. In field experiments, monthly application of 0.5% HCH over the exposed surfaces of the stack did not ensure adequate protection; apparently, the frequency of application was not sufficient.

Based on information gathered in this study on the biology and ecology of *Dinoderus* beetles, effectiveness of various insecticides, and economic and environmental considerations, a pest management strategy involving priority utilization of infested stock and minimal application of insecticide has been suggested. Regular storage of reed in the KNP yard started only in 1981 and there is risk of large-scale build-up of the beetle population in the yard over the years. It is therefore necessary to monitor the course of development of the *Dinoderus* population to make suitable modifications in the pest management strategy. Three insect parasites and one insect predator of *Dinoderus* were recorded at Mavellcor in this study, but their role in regulation of the host population remains unknown at present.

Two types of fungi were found to grow on reed–*Capnodium* spp. (sooty mould) and *Lenzites* spp. Of these, only the latter, a brown-rot fungus capable of degrading cellulose, is of concern. In reed stored for periods longer than 4 to 6 months, deterioration caused by this fungus appeared to be more serious than that caused by *Dinoderus*. Monthly spraying of boric acid-borax, which has both fungicidal and insecticidal action, gave partial control; more frequent applications may prove effective.

Further investigations are required to characterise the change in pulping quality and to quantify the loss in pulp yield in order to assess the economic advantage of controlling insect and fungal damage.

Balagopalan, M. and Alexander, T.G. *Organic matter dynamics in teak and eucalypt plantations KFRI Research Report No. 20 Final Report of the Project Soils 06/1981 December, 1983, 21 pp.*

Soil organic matter, a key component of soil, releases nitrogen, phosphorus, sulphur and other elements during its decomposition and it has beneficial effects on the physical, chemical and biological properties of soils. Clearfelling, slash burning and plantation activities can lead to positive or negative changes in organic matter content of soils. This project was initiated to evaluate organic matter changes along linear sequences in teak and eucalypt plantations in relation to natural forest.

Five sequences, Thora and Karulai for teak (*Tectona grandis*), Kadasseri and Tirunelli for eucalypts (*Eucalyptus tereticornis* and *E. grandis*) and Kollathirumed for eucalypt and albizia (*Albizia falcataria*) intermixed were selected. Soil samples were taken along the sequence at 0, 200, 400, 600, 800, 1000, 1200, 1400, 1600, 1800, 2000, 2200, 2400, 2600 and 2800 m starting from natural forest. At every sampling locale, fixing a tree as central point, 15 surface samples (0-20 cm) within a radius of 10 m and one sample each from 0-20, 20-40, and 40-60 cm layers of a central pit were taken. Altogether 1350 samples were analysed for organic carbon (OC) accordingly to Walkley and Black method. Analysis of variance was done for each sequence to ascertain the variation within OC values of 15 locales and that within 15 surface samples of each locale.

F—values are significant for the locales in all the sequences. The nonsignificance of F-values and the relatively low coefficients of variation for surface samples suggest that the OC values at each locale can be pooled. Least significant difference test shows that for the Thora, Karulai, Kadasseri, Tirunelli and Kollathirumed sequences 3, 13, 10, 1 and 3 locales have lower and 5, 0, 0, 1 and 7 locales have higher levels of OC compared to natural forest.

At Thora, OC values in teak plantations remain close to that of natural forest and plantation activities have not caused any drastic change in OC content of soils. A decline in OC levels occurs in teak plantations of Karulai sequence and this is attributable to plantation operations in the early stages of second rotation. Eucalypt plantations at Kadasseri have relatively lower contents of OC than that of natural forest and the trend at Tirunelli is opposite. At Tirunelli, well established root systems of seedling trees and the addition of branches, twigs and leaves after coppicing promote accumulation of OC. Compared to natural forest, higher levels of OC occurs in teak, eucalypt and albizia plantations of Kollathirmed.

SEMINAR, CONGRESS, LECTURES

INTERNATIONAL

Dr. S. K. Ghosh, Division of Plant Pathology (Non-Fungal diseases) attended the 10th International Plant Protection Congress at Brighton, U. K. from November 20-25, 1983. In the forestry section, he put up a poster on "Possible teak mistletoe control through trunk injection of weedicides" by S. K. Ghosh, M. Balasundaran and M. I. Mohammed Ali. During the trip Dr. Ghosh also visited Biological and Forestry Research Laboratories, Rothamsted Experimental Station, University of Wales, North Research Station, Imperial College of Science and Technology, Commonwealth Institutes of Mycology as well as Entomology in U. K. and National de Research Agronomiques, France.

Dr. R. Gnanaharan, Wood Science Division gave a lecture on "The importance of wood seasoning and furniture finishing" at the industrial workshop organised by the Small Industries Source Institute, Calicut on 18 Feb., 1984

He also attended the following meetings of the ISI, New Delhi in November 1983.

i. Timber seasoning and treatment sub committee BDC 9:3

ii. Timber treating sub committee BDC 9:9

iii. Timber conversion and grading sub committee BDC 9:10

Shri M. I. Mohammed Ali, Division of Plant Pathology (Non-Fungal Diseases) attended the National Seminar on Mycoplasmal infection in animals, plants and men during 27.29 February 1984 at College of Veterinary Sciences and Animal Husbandary, C. A. University at Mathura. He presented a paper entitled "Studies on sandal spike disease in Kerala" by S. K. Ghosh, M. Balasundaran and M. I. Mohammad Ali.

Dr. K. M. Bhat, Division of Wood Science gave a lecture on "The importance of Forest resources in the economic development of different natural regions" at Kerala Varma College on 26 September, 1983.

He also participated in the 71st Annual Session of the Indian Science Congress Association at Ranchi on 2-8 January, 1984 and presented a paper entitled "Effect of agroforestry practices on wood quality" in a satellite seminar organized by the Indian Society of Tree Science.

Dr. S. K. Ghosh, Division of Plant Pathology (Non-Fungal Diseases) attended the 36th Meeting of the Phytopathological Society of India held at Hissar, 15-18 February, 1984 and presented a paper "Control of angiospermic parasite(s) on forest trees by infusion of weedicides" by S.K. Ghosh, M. Balasundaran and M. I. Mohammad Ali.

Dr. K. S. S. Nair, Dr. R.V. Varma and Dr. George Mathew, Division of Entomology attended the 3rd Oriental Entomology Symposium held at Trivandrum 21-24 February, 1984. Dr. Nair presented a paper "Bagworms (*Lepidoptera, Psychidae)* of Kerala-their potential as pests of tree crops of Kerala." Dr. Varma presented a paper "Response of the subterranean termite *Odontotermes guptai* to eucalypt root extract." Dr. Mathew presented a paper "Insect borers of commercially important stored timber of Kerala." Dr. Nair chaired the technical session covering papers on forests, plantation crops and weeds.

Dr. J. K. Sharma and Dr. K. V. Sankaran, Division of Plant Pathology (Fungal Diseases) attended the 11th Annual Meeting of Mycological Society of India and participated in the symposium on *'Fungal resources and their utilization"* at Kerala Agricultural University, Vellayani, Trivandrum on 23–24 February, 1984.

KFRI Seminars.....

Shri K. C. Chacko	: Forest biomass (05 Sept. 1983)
Shri K. Swarupanandan	: Is there a phenomenon like hydroperiodism in plants (19 Sept. 1983)
Dr. P. S. Ashton,	: Species richness of Malesian flora (23 Sept. 1983)
Shri Mammen Chundamannil	: Forestry principles and the economic reality : An assessment of Kerala experience (03 Oct. 1983)
Dr. K. K. Seethalakshmi	: Cell wall-degrading enzymes (14 Nov. 1983)
Shri Mathew P. Koshy	: Plant isoenzymes (28 Nov. 1983)
Dr. M. H. Ivory	: Mycorrhizas in tropical pines (01 Dec 1983)
Shri N. Gopalakrishnan Nair	: Mangroves : The lost vegetation (02 Jan. 1984)
Mr. Clifford Rice	: Nilgiri Tahr (09 Jan. 1984)
Shri M. Balasundaran	: Antibiotics in plant control: specificity and mode of action (16 Jan. 1984)
Shri K. Mohandas	: Productive and helpful insects (13 Feb. 1984)
Shri E. A. Jayson	: Wildlife farming (27 Feb. 1984)

Papers presented at the National Seminar on Eucalypts, 30-31 January 1984 by the Kerala Forest Research Institute Scientists

Balagopalan, M. and Jose, A. I. Distribution of organic carbon and different forms of nitrogen in a natural forest and adjacent eucalypt plantation at Arippa, Kerala.

Bhat, K. M. Can eucalypts meet the wood quality requirements of the industries from plantation growth.

Chacko, K. C. and Muhammed, E. Polyurethane foam nursery technique for raising healthy seedlings of *Eucalyptus*.

Gnanaharan, R. *Eucalyptus* for non-pulp uses – research needs.

Krishnankutty, C. N. and Mammen Chundamannil. Eucalypt plantations in the forests of Kerala: are the goals being fulfilled.

Maria Florence, E. J., Sharma, J. K. and Mohanan, C. Occurrence of *Cryphonectria* canker disease of *Eucalyptus* in Kerala.

Mohan, C. and Sharma, J. K. Epidemiology of *Cylindrocladium* causing a disease complex of *Eucalyptus*.

Muhammad Ali, M. I., M. Balasundaran and S. K. Ghosh. Histopathological detection of little leaf disease of eucalypts in Kerala.

Nair, K. S. S., George Mathew, Varma, R. V. and Sudheendrakumar, V. V. Insect pests of eucalypts in India – present problems and trends for future.

Nair, K. S. S., Varma, R. V., Karunakaran, C. K., Muhammad, E. and Chand Basha. Control of termites in eucalypt plantations – large scale field trials.

Sankar, S. What is wrong with eucalypts?

Sharma J. K. Potential threat to exotic eucalypts in Kerala by native pathogens – how to meet the challenge?

Sharma, J. K., Maria Florence, E. J, Sankaran, K V. and Mohanan, C. Toxin bioassay, a rapid method for assessing relative susceptibility of eucalypts against pink disease.

Sharma, J. K. and Mohanan, C. Management of seedling diseases of eucalypts in nursery by container sowing method and its economic implications.

Sudheendra Kumar, V. V. and Chacko, K. C. Effect of site preparation on incidence of termites in *Eucalyptus* plantations.

Varma, R. V. and Nair, K. S. S. Evaluation of insecticides and treatment methods against subterranean termites attacking eucalypt plantations.

Forthcoming events of 1984

May 7–11. HAWAII, IUFRO Symposium on effects of forest land use on erosion and slope stability, Honolulu. Hawaii.

Contact: Dr. R, Rice, Redwood Sciences Lab., US Forest Service. 1700 Bayview, Arcata 95521, USA.

May 8. BELGIUM. Int. Symposium on Crop Protection.

Contact: Faculty of Ag. Sciences, State University, Coupure Links, B-9000 Gent, Belgium.

May 28-June 1. SWEDEN. Int. Research Group on Wood Preservation, Ronneby.

Contact: IRG 15 Organizing Committee, IRG Secretariat, Drotting Kristinas vag 47 C, S-114, 28 Stockholm, Sweden.

June 25-29. USA. Sixth North American Conference on Mycorrhiza, Bend, Oregon.

Contact: R. Molina, 6 NACOM Secretary, Forestry Service Lab., 3200 Jefferson Way, Corvallis, OR 97331, USA.

July 4. U. K. Tree fogging, London.

Contact: Dr. N. E. Stork, British Museum of Natural History, Royal Entomological Society of London, Queensgate. London.

August 19–25. CANADA. VIth International Symposium on biological control of weeds, Vancouver.

Contact: Judy Myers, Institute of Animal Resource Biology, University of British Columbia, Vancouver, Canada V6T 1W5.

September 3 - 5, 1985. JAPAN, Int. Symposium on erosion, debris flow and disaster prevention, Tsukuba.

Contact: Dr. S. Kobashi. Organizing Secretary, Dept. of Forestry, Kyoto University, Kyoto 606, Japan.

September 16 – 23. FRANCE. IUFRO Int. Symposium on Human Impacts on Forestry, Strasburg.

Contact: H. Oswald, INRA-CNBF, Station de Sylviculture et de Production, Champenoux, F-54280 Seichamps, France.

November 5-9, KENYA. 3rd Int. Conference on Apiculture in tropical climates, Nairobi.

Contact: International Bee Research Association, Bill House, Gerrards Cross, Bucks SL9 0MR, U. K.

Joined K.F.R.I. recently

Technical Staff

P.K. Chandrasekhara Pillai, B.Sc. — Field Assistant (Ecology)

K.K. Ramesh, B.Sc. — Field Assistant (Genetics)

Left K.F.R.I. recently

Scientific Staff

V.P.K. Nambiar, M.A., M.Sc., — Scientist (Botany—Taxonomy)

S.K. Ghosh, Ph.D. — Scientist (Plant Pathology—NF)

Administrative Staff

Kum. V. Dhanalakshmi — Stenographer

Visitors

1. Dr. Peter Ashton
   Director, Arnold Arboretum,
   Harward, U.S.A. — 22-9-1983
2. Mr. William R. Bentley
   Programme Officer,
   The Ford Foundation,
   New Delhi. — 22-9-1983
3. Mr. Clifford Rice
   Dept. of Wildlife &
   Fish. Science, Texas
   A & M Univ., Texas — 09-1-1984
4. Dr. M.H. Ivory
   University of Oxford,
   Dept. of Agriculture and Forestry Science,
   Commonwealth Forestry Institute
   Oxford, U.K. — 30-3-1984
5. Mr. W. Finlayson
   Director, Commonwealth
   Forestry Institute, U.K. — 23-3-1984
6. Mr. H.L. Wright
   Commonwealth Forestry Institute,
   Oxford, U.K. — 23-3-1984

More quarters for the staff...

Ten more Type I quarters are ready for occupation. Construction of 10 more Type II quarters have already started.

'Haritha' released

Mrs. Maria Florence receives the malayalam manuscript magazine of the KFRI staff association **Haritha** from Dr. S. Kedharnath, Director on 3rd February, 1984.

David Nelson

Let us repeat the name and pay homage to the one who collected the specimen on which the name *Eucalyptus* is based.

A tragic hero among the great plant hunters, David Nelson collected many plants and specimens for Kew gardens. His specimen from Adventure Bay (Tasmania) collected during January, 1777, preserved at the British Museum Herbarium is regarded to be the one on which L' Heritier raised the genus *Eucalyptus* in 1783. David Nelson died on 20th July 1789 at Timor after a terrible voyage of 4,500 miles at sea in an open boat for fortyseven days, which was the result of a mutiny on the ship Bounty commissioned to transport plants of the bread fruit from Tahiti to the West Indies.

Eucalyptus obliqua L' Herit.

The name *Eucalyptus* was derived from two Greek words: 'eu' = 'well' and kalyptos= 'I cover'. L'Heritier's name (refers to the calyptra of firmly connate petals, which protects the stamens in bud and falls off at the expansion of the flower)is apt today. It does cover well—with about 600 species the genus *Eucalyptus* covers about 95% of the total trees of the Australian Continent and has already found a place in the plantation forestry all around the world.

Behind every popular exotic there is always a forgotten story — the sufferings of Botanists.

A Special Feature

national seminar on eucalypts

The National Seminar on Eucalypts was held on 30-31st January, 1984 at Kerala Forest Research Institute, Peechi. The Seminar was organised by Kerala Forest Research Institute in collaboration with Kerala Forest Department and cosponsored by Indian National Science Academy (Kerala Chapter), Department of Science and Technology and Department of Environment, Govt. of India. A total of 200 delegates from various states of India participated in the Seminar.

Inauguration

Presidential address

"This National Seminar, in my opinion, has been very timely and it is appropriate that the Kerala Forest Research Institute took the initiative to convene this and thus provide an useful forum for sharing the knowledge and experiences hitherto gained in growing eucalypts and to chalk out an action programme for the future..... we cannot afford to commit mistakes and it is imperative that whatever programmes we undertake are based on adequate data.....

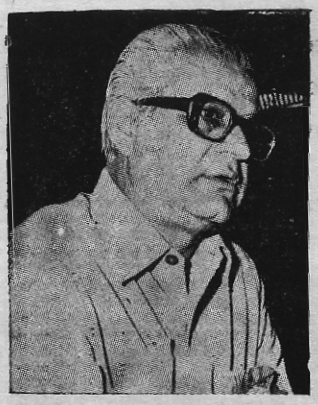
Considering the diversity within the country and the complexity of the problem, it may not be possible to identify a universally applicable solution. Nevertheless it is important that the issues are clearly sorted out so that decision makers are able to get a clear idea of the future course of action. People have a lot of expectations from this seminar....."

K. P. Noorudin
Hon. Minister of Forests, Govt. of Kerala.

Inaugural address

"In our country at present, there is a considerable debate on forestry practices as also on merits and demerits of individual forest species..... there have to be two principal types of forestry-conservation and production Both these are equally important and are not mutually exclusive .... In any case the basic idea is to utilise indigenous species ..... There is no scope for exotics in ecologically sensitive areas... ...Eucalypts if planted in a conservation area is bad, but it can be a blessing in a captive plantation where we can have tree farming on flat lands in the plains away from conservation areas, where objective is commerical to remove pressure on natural forests, as also where water and other inputs are available..... .....It is clear that there is a need for more scientific data to draw up parameters regarding the type of land and other inputs necessary to raise eucalypt plantations successfully. It is also clear that eucalypt plantations should on no account replace natural forest. But could, however, be grown successfully on marginal or degraded land without any major disadvantages."

Dr. T. N. Khoshoo, Secretary
Dept. of Environment, Govt. of India, New Delhi

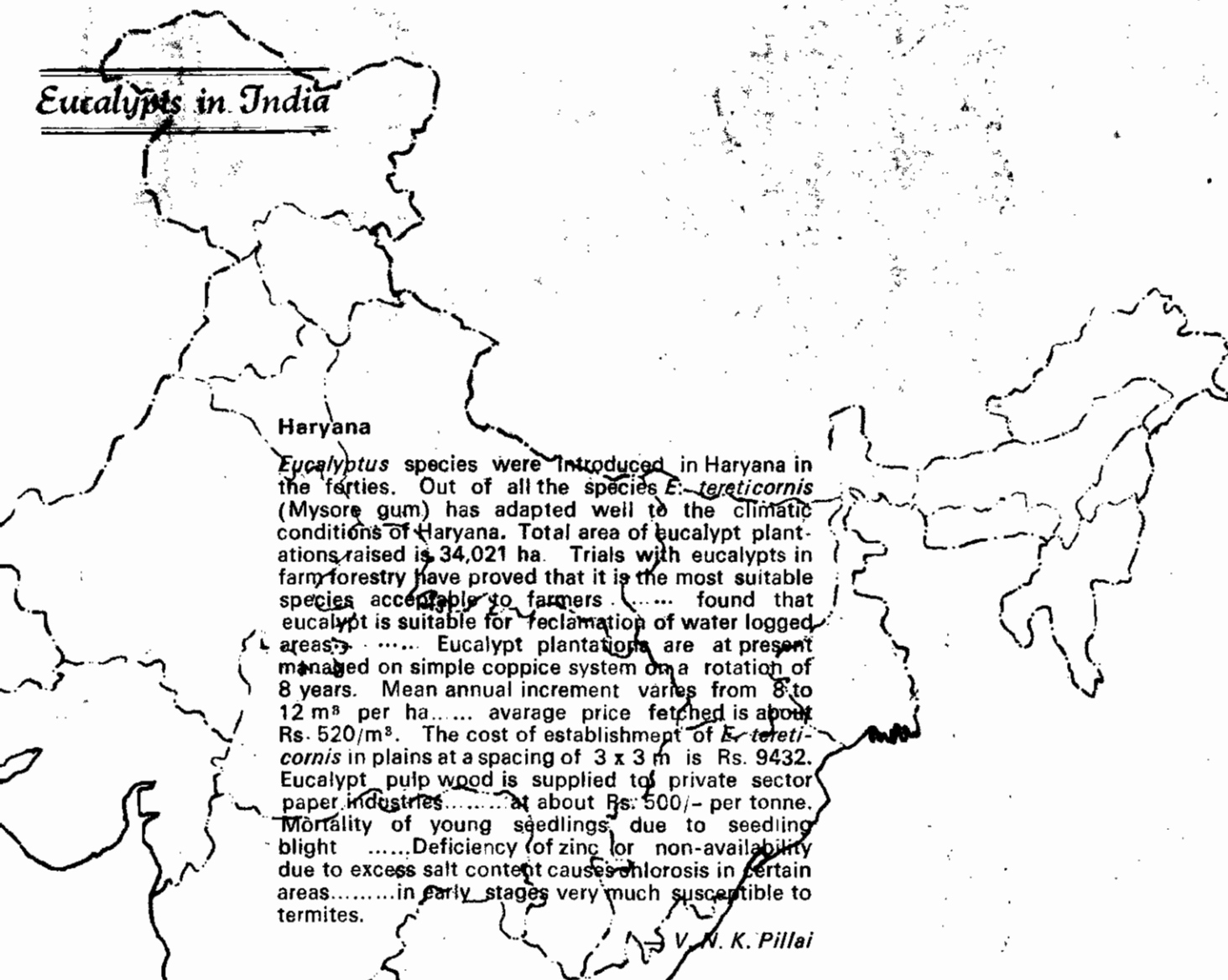


Keynote address

"Forests are today not only sources of valuable products, but also important basis of our environment which supports and maintains the very life itself ..... Forest resources are always subject to socio-economic compulsions from time to time .. .. During recent years forest resources underwent a change from conservation oriented management to forestry for the people..... ..... Forestry today is a form of land use like agriculture and horticulture. Evaluation in forest management and strategy has taken foresters in India to a new approach. The focus is on natural development through multipurpose tree crops rather than forestry in the traditional way whether it is in the farm or in the forests or among the existing different crop patterns. It is no more the foresters monopoly.. The message is clear—forest and forestry for the people and their progress, for the good and developments of all those who are concerned especially the poorer sections of our community. Let us thrive towards the new objective to uplift the down trodden, through the great resource that is forestry."

C. L. Bhatia
I G of Forests, New Delhi.

Eucalypts in India



Haryana

Eucalyptus species were introduced in Haryana in the forties. Out of all the species *E. tereticornis* (Mysore gum) has adapted well to the climatic conditions of Haryana. Total area of eucalypt plantations raised is 34,021 ha. Trials with eucalypts in farm forestry have proved that it is the most suitable species acceptable to farmers ..... found that eucalypt is suitable for reclamation of water logged areas ..... Eucalypt plantations are at present managed on simple coppice system on a rotation of 8 years. Mean annual increment varies from 8 to 12 m^3 per ha..... avarage price fetched is about Rs. 520/m^3. The cost of establishment of *E. tereticornis* in plains at a spacing of 3 x 3 m is Rs. 9432. Eucalypt pulp wood is supplied to private sector paper industries..... at about Rs. 500/- per tonne. Mortality of young seedlings due to seedling blight .....Deficiency of zinc or non-availability due to excess salt content causes chlorosis in certain areas.....in early stages very much susceptible to termites.

V. N. K. Pillai

Karnataka

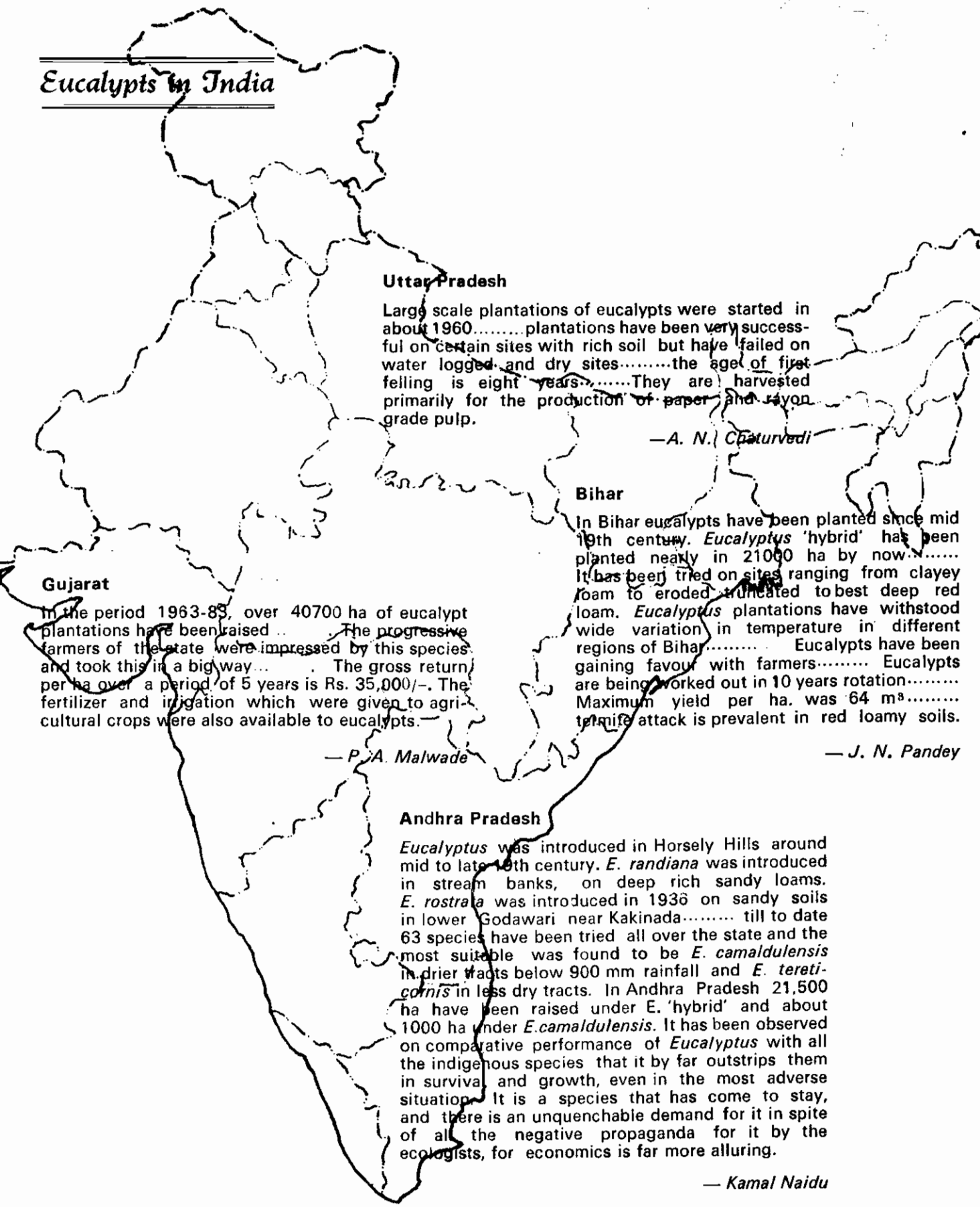
Nandi Hills received *Eucalyptus* during 1870. The total extent of *Eucalyptus* plantations raised in Karnataka is around 1,10,000 ha..... planting of *Eucalyptus*..... confined to the zone receiving a rainfall of 500 to 1125 mm. Mortality due to white ant is common and would account for a loss of about 15-20%..... addition of small doses of chemical fertilizer (NPK) is adopted..... The rotation adopted in the case of the pure *Eucalyptus* plantation in the state is 10 years..... the yield averaging to barely 12 t/ha. *Eucalptyus* plantations, since 1976 have only been raised in degraded areas..... The watershed, wherever planted with eucalypts has improved.

— S. Shyam Sunder

Kerala

Raising commercial plantations of eucalypts started in 1958..... about 30,000 ha of eucalypt plantations spread over Western Ghats. The economic appraisal of *Eucalyptus* plantation projects in Kerala may indicate apparent financial liability due to the fact that wood is measured out to a major industry at concessional rate, even though these plantations are yielding an acceptable rate of wood return..... requirement of *Eucalyptus* wood to meet Government commitment to various industries in Kerala is 3,30,000 t per year..... The expected annual yield of the existing *Eucalyptus* plantations is about, 2,70,000 t only. Hence there is imperative need for intensive and extensive *Eucalyptus* planting programme. *— A. Hassankutty*

Eucalypts in India



Uttar Pradesh

Large scale plantations of eucalypts were started in about 1960.....plantations have been very successful on certain sites with rich soil but have failed on water logged and dry sites.....the age of first felling is eight years.....They are harvested primarily for the production of paper and rayon grade pulp.

—A. N. Chaturvedi

Bihar

In Bihar eucalypts have been planted since mid 19th century. *Eucalyptus* 'hybrid' has been planted nearly in 21000 ha by now..... It has been tried on sites ranging from clayey loam to eroded truncated to best deep red loam. *Eucalyptus* plantations have withstood wide variation in temperature in different regions of Bihar..... Eucalypts have been gaining favour with farmers..... Eucalypts are being worked out in 10 years rotation..... Maximum yield per ha. was 64 m^3..... termite attack is prevalent in red loamy soils.

— J. N. Pandey

Gujarat

In the period 1963-83, over 40700 ha of eucalypt plantations have been raised . . . The progressive farmers of the state were impressed by this species and took this in a big way . . . The gross return per ha over a period of 5 years is Rs. 35,000/-. The fertilizer and irrigation which were given to agricultural crops were also available to eucalypts.

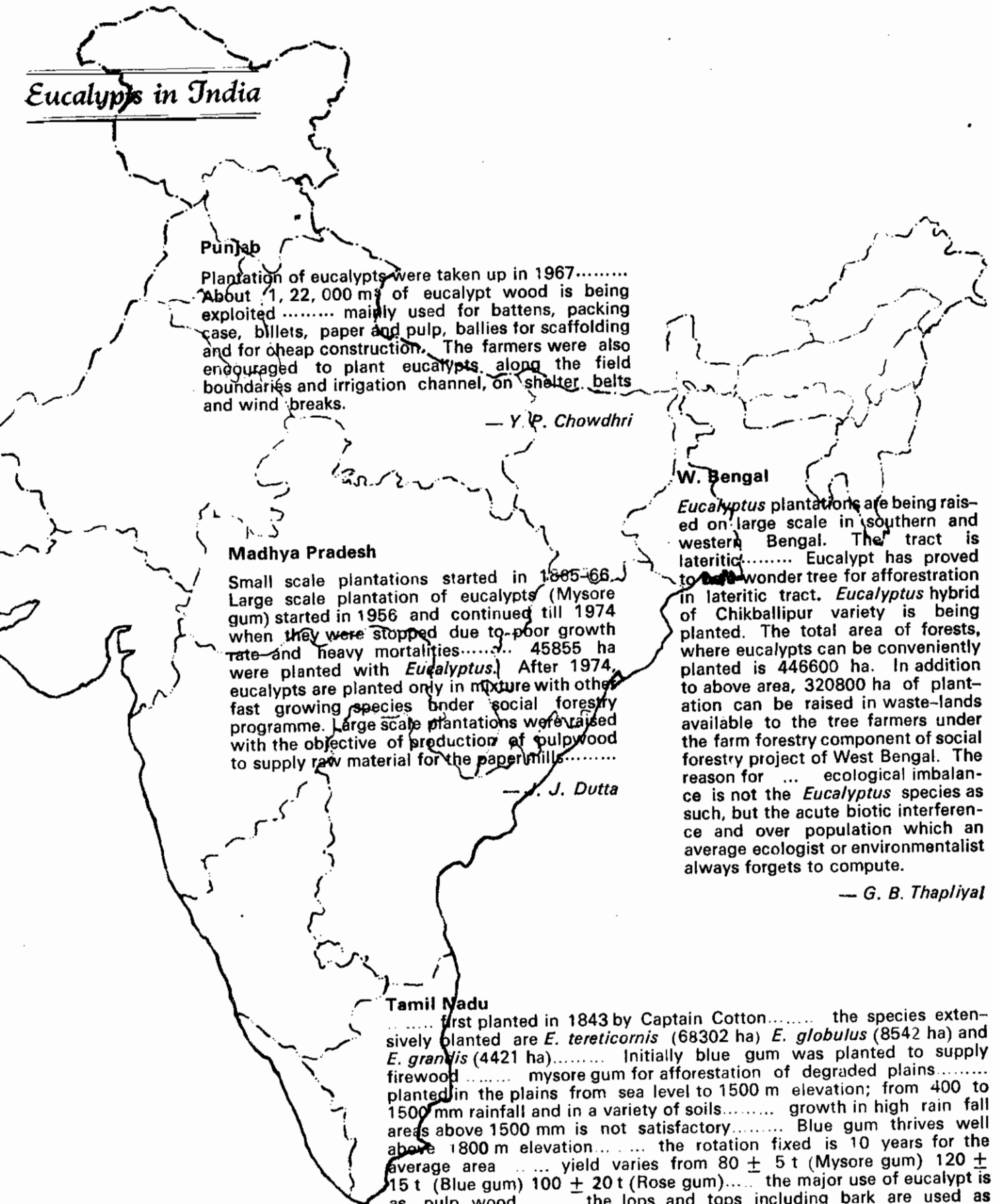
— P. A. Malwade

Andhra Pradesh

Eucalyptus was introduced in Horsely Hills around mid to late 19th century. *E. randiana* was introduced in stream banks, on deep rich sandy loams. *E. rostrata* was introduced in 1930 on sandy soils in lower Godawari near Kakinada..... till to date 63 species have been tried all over the state and the most suitable was found to be *E. camaldulensis* in drier tracts below 900 mm rainfall and *E. tereticornis* in less dry tracts. In Andhra Pradesh 21,500 ha have been raised under E. 'hybrid' and about 1000 ha under *E.camaldulensis*. It has been observed on comparative performance of *Eucalyptus* with all the indigenous species that it by far outstrips them in survival and growth, even in the most adverse situation. It is a species that has come to stay, and there is an unquenchable demand for it in spite of all the negative propaganda for it by the ecologists, for economics is far more alluring.

— Kamal Naidu

Eucalypts in India



Punjab

Plantation of eucalypts were taken up in 1967..... About 1, 22, 000 m³ of eucalypt wood is being exploited ..... mainly used for battens, packing case, billets, paper and pulp, ballies for scaffolding and for cheap construction. The farmers were also encouraged to plant eucalypts along the field boundaries and irrigation channel, on shelter belts and wind breaks.

— Y. P. Chowdhri

Madhya Pradesh

Small scale plantations started in 1965-66. Large scale plantation of eucalypts (Mysore gum) started in 1956 and continued till 1974 when they were stopped due to poor growth rate and heavy mortalities..... 45855 ha were planted with *Eucalyptus*. After 1974, eucalypts are planted only in mixture with other fast growing species under social forestry programme. Large scale plantations were raised with the objective of production of pulpwood to supply raw material for the paper mills.....

— J. J. Dutta

W. Bengal

Eucalyptus plantations are being raised on large scale in southern and western Bengal. The tract is lateritic..... Eucalypt has proved to be a wonder tree for afforestration in lateritic tract. *Eucalyptus* hybrid of Chikballipur variety is being planted. The total area of forests, where eucalypts can be conveniently planted is 446600 ha. In addition to above area, 320800 ha of plantation can be raised in waste-lands available to the tree farmers under the farm forestry component of social forestry project of West Bengal. The reason for ... ecological imbalance is not the *Eucalyptus* species as such, but the acute biotic interference and over population which an average ecologist or environmentalist always forgets to compute.

— G. B. Thapliyal

Tamil Nadu

..... first planted in 1843 by Captain Cotton..... the species extensively planted are *E. tereticornis* (68302 ha) *E. globulus* (8542 ha) and *E. grandis* (4421 ha)..... Initially blue gum was planted to supply firewood ..... mysore gum for afforestation of degraded plains..... planted in the plains from sea level to 1500 m elevation; from 400 to 1500 mm rainfall and in a variety of soils..... growth in high rain fall areas above 1500 mm is not satisfactory..... Blue gum thrives well above 1800 m elevation..... the rotation fixed is 10 years for the average area ..... yield varies from 80 ± 5 t (Mysore gum) 120 ± 15 t (Blue gum) 100 ± 20 t (Rose gum)..... the major use of eucalypt is as pulp wood ... the lops and tops including bark are used as firewood... .. the leaves are used for the manufacture of oil..... there is no evidence to show that the water management is any way affected adversely..... the component of eucalypts however does not extend 7% of the total planting under social forestry... *— S. Kondas*

Eucalypts and environment

Depletes our soil nutrients...

Distribution of organic carbon and different forms of nitrogen in soils under a natural forest and an adjacent eucalypt plantation..... it was found that the soil pH was lower in eucalypt plantation when compared to natural forest. Cation exchange capacity and organic carbon were also lower in soils under eucalypt plantation..... within a span of seven years, there was relatively higher oxidation in the soil of eucalypt plantation, while in the natural forest it was practically negligible.

— M. Balagopalan (Kerala)

Enriches our soil...

Over half the rotation of 10 years, the data show a definite improvement in the organic carbon, available phosphorus and also soil structure. There is complete stability in soil pH disproving the fear that the soil under eucalypts would turn acidic.

— K. A. Kushalappa (Karnataka)

Not so thirsty...

The study does not reveal any adverse effect on hydrological cycle due to planting of blue gum ..... neither there was evidence that ground water and soil moisture regime and water quality have been upset adversely due to blue gum planting.

— N. Francis Raj (Tamil Nadu)

Yes, it is so...

During the first rotation, the blue gum does not interfere with the ground water and the roots remain well above the ground water table..... the recycling of nutrients by blue gum keeps the land under high fertility status with rich top soil and dense vegetation.

— P. Samraj (Tamil Nadu)

The culprit...

Eucalypt is a heavy-consumer of water and depletes the ground water quickly..... as the plants grew, water level in the wells and ponds began going down.

— M. K. Prasad (Kerala)

Silviculture and management

A new nursery technique...

The conventional method of raising eucalypt seedlings can be substituted with the new technique using polyurethane foam sheet as a substratum for germination of seeds.

—K. C. Chacko (Kerala)

Low cost regeneration...

By reducing the cost to a reasonable level, *Eucalyptus* plantation can be made profitable. This involves planting 10-week-old container raised seedlings in 20 cm^3 pits. Expenditure..... less by 38% under taungya and 23% without taungya.

—M. K. Abdulkareem (Kerala)

Yet to improve...

The realized yields fell short of the projected yield by a factor 5.20 times. The major reasons for the low yield are low stocking, poor growth and excessive influence of biotic factors.....Successful plantation could only be raised by involving wood based industries, farmers and local bodies.

S. Narendra Prasad (Karnataka)

Manuring—good prospects...

Biomass yield of one year old *Eucalyptus grandis* plantation increased 16 fold (on fresh weight basis) and 9 fold (on dry weight basis) due to the application of urea and superphosphate.

—S. K. Sharma (Kerala)

Valuable in land reclamation...

Preliminary soil–vegetation survey was undertaken in the grasslands in Kulamavu area of Idukki District, Kerala ... studies on morphological, physical and chemical properties of these soils indicate that grasslands in these areas are not suitable for introduction of *Eucalyptus* ... if adeuqate measures like soil working, fertilizer application, etc. are carried out these grasslands can be successfully converted into *Eucalyptus* ecosystems.

—K. G. Prasad (Kerala)

There is scope in grasslands...

To afforest vast stretches of grasslands in Kulamavu with *Eucalyptus grandis* have not been successful ..... the pit size and micronutrients have no pronounced effect on growth ..... while a combination of nitrogen and phosphorus boosted the growth to twice the normal rate.

—Madhavan Nair (Kerala)

Not alone any way...

In eucalypt plantations, ground flora is found to be maximum during the younger stages. As the plantation grow older ground vegetation gets significantly reduced to few plants distributed sparcely. The ground flora is drastically reduced to very few plants in the coppice forests.

- Dasappa (Kerala)

Weedicides in use

Basoline appears to be a promising weedicide for control of weeds in *Eucalyptus* nursery.

—Swami Rao (Karnataka)

Genetics & Tree improvement

Towards higher biomass ···

Nursery screening of seedling performance followed by progeny trial resulted in the choice of over 25 single trees fit for providing a genetic base for developing a high yielding strain. The progress made so far indicates the possibility of increasing the biomass production and maintain it at a level more than three times the present yield by evolving high yielding strain through mass selection and recombination breeding.

—M. Rathinam (Tamil Nadu)

Provenances prove possibility...

As a long term solution to pink disease problem and to identify improved cultivars with respect to growth and disease resistance, multilocational provenance trials were taken up since 1978. .....provenances 11681 is found to be resistant to pink disease and also shows good growth increment. Provenances 12409, 13326 and 13365 are also promising.

—Madhavan Nair (Kerala)

Tamil Nadu on the go···

Tree improvement programme has been initiated in all the three species. *(E. grandis, E. tereticornis E. globulus)* ..... seeds from selected stands are collected, tested and supplied.

—G. Kumaravelu (Tamil Nadu)

Is the path right ..

The genetic base upon which we are building up tree improvement is so narrow. Frequent inflow of material from out side should take place .. . seed collection methods and practices at present are very much unscientific and need total change.

—S. Kondas (Tamil Nadu)

Tissue culture...

Eucalyptus grandis ... Multiple shoots were obtained from axillary shoot meristem within 4 to 5 weeks on basal media, supplemented with naphthalene acetic acid and benzylamino purine. Rooted plantlets were obtained by this method ..... somatic embryos were successfully induced and anatomical studies were carried out to confirm bipolar embryos. Thousands of embryoids were obtained in a single flask.

—Lakshmi Sita (Karnataka)

Pests and diseases

Lone enemy-termites....

About 60 insect species are found to feed on eucalypts ... none except subterranean termites have assumed pest status ..... root feeding termites cause high mortality of young plants ..... Fortunately the termite damage can be prevented by simple insecticide treatment.

—K. S. S. Nair (Kerala)

Fungal diseases ... the tragedy...

Healthy growth and survival of *Eucalyptus* is seriously threatened by three native pathogens..... *Cylindrocladium* in nursery and *Cylindrocladium* spp., *Corticium salmonicolor* and *Cryphonectria cubensis* in plantations .....humid climate is partly responsible for this.

—J. K. Sharma (Kerala)

Cankers.....

Cryphonectria cubensis is responsible for causing severe stem cankers in *Eucalyptus grandis* in Kerala. Cankers are characterised by the exudation of ruby coloured kino. Fresh cankers develop near the old ones which coalesce to form large cankerous area more than three meters in length,

— E. J. Maria Florence (Kerala)

A disease complex...

Eucalyptus is possibly the only host where at least seven species of *Cylindrocladium* are associated with various diseases at different phases of growth .....in nurseries *Cylindrocladium* spp. cause a disease complex comprising of damping-off, seedling blight stem cankers, leaf blight and shoot blight.

—C. Mohan (Kerala)

Rapid testing - toxin bioassy...

Employing a phytotoxin produced by *Corticium salmonicolor* a technique has been standardised for assessing the relative susceptibility of different eucalypts to pink disease.

—K. V. Sankaran (Kerala)

Little leaf mycoplasma on the spread...

Large scale spread and monoculture of eucalypts have posed problems of incidence and spread of little leaf disease associated with mycoplasma like organisms. Lack of awareness, possibly regarding the role of dispersal of plants in the dissemination of plant pathogens has been responsible for such a situation.

—S. Misra (Rajasthan)

Little leaf – early detection...

Little leaf disease of eucalypts is observed in plantations of Kerala..... Fresh sections of infected tissue when treated with Diene's stain showed several regularly distributed distinct areas in the phloem tissue. The infected cells could also be detected under fluorescent microscope using the flurochrome aniline blue..... these simple microscopic studies can be used for routine detection of the little leaf disease of eucalypts.

— M. I. Mohammed Ali (Kerala)

Agroforestry & Utilization

Eucalypts – a farmers' bliss...

Rainfed cultivation of eucalypts seems to be one of the ideal model for economic development of farmer .....it would be possible to effectively bring many farmers above poverty line as well as contribute towards rapid development in social forestry programmes.

—Amit Vasavada (Gujarat)

In agroforestry ..

Since *Eucalyptus* is a soil stabilizer, requires less water for growth than most fast growing species, helps in maintaining fertility of the available land, reduces competition for nutrients by virtue of having mycorrhizal associations different than those of agri-land crops, there is no reason to doubt its usefulness in agro-forestry programmes to provide fulewood in short time.

— Dinesh Kumar (New Delhi)

Oh No, it is not so...

Eucalyptus has been officially recommended for afforestation on farmlands.....there are deeper and to a large extent hidden social and market forces behind the quick spread of eucalypts.

—Vandana Shiva (U. P.)

Gift from above ..

Eucalyptus 'hybrid' has become the tree of the farmer ..... *Eucalyptus* plantations have begun to change the land use pattern in Punjab..... their contribution to the state economy is expected to increase tremendously .. *Eucalyptus* is suggested as a viable alternative to agricultural crops.

—A. S. Dogra (Punjab)

Good for arid zones ..

Owing to their extreme adaptability to adverse edaphic and climatic conditions, they have been found to be suitable..... for afforestation in the arid zones for production of fuelwood.

—K. D. Muthana (Rajasthan)

Banks at help ..

Eucalyptus meets the bank's criteria for giving loans .. .... it is possible to repay the loan in a short period.....

—Venkataraman (NABARD)

Banks lure the farmers ..

It is not wise to select *Eucalyptus* for farm forestry without any experimental data on soils, ecology and its inter-relationship with agricultural crops. Social forestry should meet the basic needs of the rural population and not the requirements of the industry. *Eucalyptus* should be banned from farm forestry and restricted to industrial plantations – banks are luring people into ecological disasters.

—J. Bandyopadhyay (Karnataka)

On farmers own interest ..

Foresters are not propagating *Eucalyptus* but are only responding to the farmers demands – infact farmers are preferring *Eucalyptus* to other species, the main reason being its non-browsing character.

—D. N. Mishra (U. P.)

For paper-ideal choice ..

The Mysore Paper Mills is planning for 30,000 ha captive plantations of eucalypts which is anticipated to produce 75,000 tonnes of raw material.

—U. T. Alva (Karnataka)

Uses are many more...

On the basis of physical and mechanical properties, *E. tereticornis* is found to be 10% heavier, 15% harder and 15% higher in shock resisting ability in comparison to teak. Though *E. tereticornis* belongs to nondurable and nontreatable classes, with proper care it can be used for making simple as well as beat wood furniture, tool handles, pallets, over head power and telecommunication line-poles.

—S.S. Rajput (U.P.)

Research needs are many ..

As wood properties of trees planted in exotic environment will often be strikingly different from those in their indigenous environment, a clear understanding of the characters of wood is essential for its effective use..... ...important wood characteristics like specific gravity, strength, shrinkage, etc., features like grain, knots, kinoveins, growth stress, etc. need to be studied in depth and base data generated.

—R. Gnanaharan (Kerala)

But ..

There is already an indication that many of these defects can be effectively controlled by genetic manipulation.

—K. M. Bhat (Kerala)

Socio-economic aspects

Not at the risk of tribals···

In Kerala *Eucalyptus* plantations are raised after clearfelling the natural forests. The consequence of conversion is directly and in dire proportion hurtful to the tribal way of life. ...Before any additional forest is converted to eucalypt plantations, a careful impact study should be undertaken.

—*T. Madhava Menon (Kerala)*

Not at the risk of water···

Eucalypt is a heavy consumer of water and depletes the groundwater quickly. The incalculable ecological and social damage these plantations incur has not been considered at all by the eucalypt protagonists.

— *M. K. Prasad (Kerala)*

Not at the risk of environment···

The common man fears that eucalypt plantation programme lacks adequate commercial justification and has adverse environmental and social effects.

—*S. Sankar (Kerala)*

Not at the risk of revenue···

As public land and funds are utilised in growing eucalypts there has to be convincing social and/ or economic justification, especially if the return do not match with the expenditure.

—*C. N. Krishnankutty (Kerala)*

Not at the risk of natural forest...

Eucalyptus at any cost should not be planted by cutting down our valuable natural forests.

—*C. K. Karunakaran (Kerala)*

But for the sake of industry···

The existing plantations in the state are not capable of meeting the requirement of the industries. Hence a vigorous afforestation programme, jointly with the pulp and paper industries is the need of the hour.

—*K. C. Goyal (Kerala)*

Recommendations

THE NATIONAL SEMINAR ON EUCALYPTS held at Kerala Forest Research Institute, Peechi, Kerala having deliberated on various aspects of eucalypts planting in India makes the following recommendations:

1. Realizing the importance of maintaining the ecosystem, ecologically sensitive forest areas should not be planted with eucalypts and an all out effort should be made to regenerate such areas with indigenous species.

2. Realizing the growing demand and daily needs of the people/rural masses for firewood, poles and small-size timber, planting of eucalypts should be continued in suitable areas so that the gap between the demand and supply is bridged as early as possible.

3. In view of the multipurpose use of eucalypts for housing and other purposes, marginal trees in the plantations of eucalypts be allowed to grow to large sizes to provide timber.

4. As there is further need for study with regard to the effect of the different species of *Eucalyptus* on wood qualities, organic matter, nutrient status, surface water run-off, ground water and water conservation under varying edaphic and climatic conditions and use of fertilizer and pesticides, research on these aspects be intensified.

5. With a view to evolve suitable genetic strains of eucalypts to suit various agro-climatic regions, intensive genetic research be undertaken on a priority basis.

6. As eucalypts are being planted as a short-rotation crop to be utilised as small timber, firewood and pulpwood and is being managed under coppice system-detailed investigations regarding the extent of its coppicing power and the number of coppice rotations along with the yields should be carried out.

7. As eucalypts are being planted on a large scale by farmers along the field boundaries and sometimes as an inter crop with various agricultural crops like sugarcane, wheat and others, detailed investigations be carried out on the interaction of eucalypts with various agricultural crops.

8. In future, before introducing eucalypts in tribal areas, a careful impact study on the welfare of tribal population should be undertaken.

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No. 2 (2)* KFRI. 1978. Availability of wood raw-materials for plywood industry-North-Eastern Region. Final report of research project sponsored by the Federation of Indian plywood and Panel Industry, Part-2,85 pp (Mimeographed).

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No. 11 Varma, R V. 1982. Investigations on the possibility of non-insecticidal control of termites. Final report of the research project Entom 06/1979 January 1977-December 1980, 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 report of research project Wood 04/1980. July 1980 to September 1981, 24 pp.

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No. 15 Gnanaharan R. and Mathew, George. 1982. Preservative treatment of rubber wood *(Hevea brasiliensis)*. Final report of research project Wood 03/1979; 16 pp.

No. 16 Nair, K. S. S. 1983 Seasonal incidence, host range and control of the teak sapling borer, *Sahyadrassus malabaricus*. Final report of research project Entom 08/79, January 1979 to June 1981, 36 pp.

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

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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 diseases of eucalypts in Kerala and their control, (English & Malayalam), Division of Pathology (Fungal Diseases), 16 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 680653, Kerala, India.*