RUBBER AND HIGH SHADE*

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SUPERINTENDENT, GOVINNA ESTATE, GOVINNA

MUCH attention has been given lately to "forestry" methods in rubber. Briefly, these deal with the encouragement and control of a sub-jungle growth of Hevea seedlings and suitable indigenous bushy types. It is not the writer's intention to comment on these beyond reiterating what he wrote sixteen years ago, that it should be our aim to re-create, as nearly as practicable, the conditions of a forest soil. At present the argument lies, in Ceylon at least, between the advantages and disadvantages of ground cover such as Vigna and Pueraria, or bushy growths, and there is much to be said for and against both.

It is the purpose of this article to show that neither nor both fully meet the case.

THE EVERGREEN TROPICAL RAIN FOREST

I am indebted to the Economic Botanist, Peradeniya, who, on enquiry, kindly furnished the following information culled from Herbert Wright's "Foliar Periodicity of Endemic and Indigenous Trees in Ceylon", (Annals R. B. G. Perad. 11. 1905) and Fred Lewis's "The Altitudinal Distribution of the Ceylon Endemic Flora", (Annals R. B. G. Perad. X. 1926).

"The total number of observed deciduous endemic species . . . is 17, or less than 3 per cent. of the arborescent flora, or 6 per cent. of the endemic trees in Ceylon. Though the percentage number of deciduous indigenous species is higher than this, it is nevertheless small, and the vegetation may therefore be regarded as *mainly evergreen* throughout the Island." (Italics mine).

Of the above species *Ficus infectoria* is doubtfully endemic, and *Canthium macrocarpum* has not been recorded below 3,000 feet. This reduces the number of species to 15, or much less than 3 per cent. Be it noted that all but one of the above are found in the wet (S.W.) zone. In fact only one deciduous species has been able to adapt itself to the long drought

*The Editor welcomes papers on subjects of general agricultural interest from outside contributors, but does not accept any responsibility for the views expressed therein.

conditions of the dry zone, and less than 3 per cent. have established themselves in the wet zone, where the inter-N.E. and S.W. drought is normally of not more than a month's duration. Nor is this a full statement of the case. The writer has not had an opportunity of taking a census of the relative numbers of the members of each species present in a wet zone forest, but he is in a position to observe daily some thousands of acres of jungle and it is undeniably plain that even during the " wintering " period of rubber nothing like 3 per cent. of the forest trees are " wintering." Moreover, such deciduous trees as can be observed, with a powerful prismatic, are, for the most part solitary. Unmixed colonies are rare, and the jungle, even during the longest droughts, presents an almost unbroken dense green canopy. Beneath this canopy ideal conditions for the production, maintenance, and functioning of a living soil obtain. Throughout the wet zone tropical belt of the world the forests for all practical purposes, may be called entirely evergreen.

This is a significant fact. Over aeons of time there must be a close adaptive relationship between the Soil and the Plant. From the fact that a small number of deciduous trees can and do flourish in wet zone jungles it may be assumed that the deciduous habit is, of itself, probably no great handicap to the tree. On the other hand, were the deciduous habit on an entire forest to react, over a long period, unfavourably on its soil under tropical conditions, it is reasonable to suppose that, in time, the soil would no longer be capable of supporting the trees and that they would ultimately be replaced by evergreens which, not only by themselves, but by the other phyla they encourage, would re-create a stable oecological condition.

HEVEA IS DECIDUOUS

We have felled evergreen jungles which through geological ages have adapted themselves to tropical conditions and which have, undeniably, maintained the balance of humus. In place of this we have planted " forests " of deciduous trees, which, even in their Brazilian home, we know, are comparatively few and far between. We have, in fact, created an oecological monstrosity.

It is the writer's belief that until that fact is realized we shall not get down to essentials of soil maintenance in rubber. If one looks over a vast area of " wintering " rubber and compares it with a similar area of jungle one must be struck with the fact that the one is creating conditions of desiccation and erosion which, in the long run, no manurially economic remedy, nor cover crop, nor bushy "forestry" methods can make good, whereas the jungle gives a hint as to a working compromise.

MANURE

It is clearly not possible for us to interplant evergreen trees in sufficient numbers fully to reproduce evergreen forest conditions, unless such trees were of economic importance; so far we know of none, but it is possible that we can interplant a number sufficient to reduce our soil losses to within an economically replaceable amount. If such trees were nitrogenous they might go far towards meeting our nitrogen bill. If they were deep rooting they would, in normal laterite soils, supply all necessary potash. Nitrogen and potash are the two most expensive units, phosphoric is the cheapest, and it so happens that this is the unit to which legumes most readily respond. The phosphoric manuring of such evergreen leguminous trees may offer a cheap alternative to the present expensive and economically doubtful methods of direct application, provided that the number of evergreens per acre does not reduce the stand of rubber out of proportion to the benefits.

This opens two avenues to work on—(*a*) old rubber, (*b*) budded clearings. It is now tardily recognised that when the first bud from a high yielding scion was established it began a new era in rubber growing. The problem for those who intend to remain in the industry is no longer whether to replant or not, but how to effect the transition at a minimum cost, and how to retain the soil, and the trees last to be replanted, in the best condition at the least expense.

The complete replanting of most estates, if only for financial reasons, must take many years, meanwhile it will become an increasingly difficult and expensive problem to maintain the oldest areas in a condition for economic production. It may be that by sacrificing a sufficient number of the lowest yielders an adequate number of high shade trees could be established and that they would, in the long run, reduce the cost of maintenance. In clearings or replanted areas the establishment of high shade is not only easy but, as wind-breaks alone, is definitely beneficial.

ALBIZZIA MOLUCCANA IN RUBBER

In 1924 the writer and a friend visited South India and we were much impressed by the healthy condition of rubber growing under and round albizzias at a time when all South Indian rubber had been reduced to a shocking condition by repeated attacks of *Phytopthora Meadii* leaf-fall. There are three probable reasons for this—(1) the extra nitrogen and better soil conditions, (2) the wind-break effect, (3) control of the method of attack of the fungus.

(1). Ashplant found that heavy doses of nitrogen were beneficial against Phytopthora, but uneconomic. Nitrogen, apparently, did little directly to modify the attack, but excessive doses tended to reduce the pod formation (the source of the leaf disease), and increased the photosynthetic ability of the leaves which survived. The writer saw these trials and it was plain that no leguminous tree could release such stores of plant food and that the explanation must be sought mainly elsewhere.

(2). From the purely mechanical point of view anything which stops wind must arrest the carriage of spores. High trees are the most efficient wind-breaks, whereas a gale may be blowing in the tree tops, the lower levels of a forest are usually calm. Even a ten mile breeze blowing for 10 hours would mean that no less than 528,000 cu. ft. of spore infected air would impinge on every square foot of leaf surface exposed to it. In the case of such a disease as Oidium which apparently can attack either surface of a tender leaf this would be an important factor for it is only in the topmost strata of a forest that there is an appreciable lateral movement of the air.

CONTROL OF THE METHOD OF ATTACK OF THE FUNGUS

(3). In the case of Phytopthora this is probably the most important service performed by albizzias. In this connection the two principal facts are that (*a*) the spores can only attack the underside of the leaf or petiole, (*b*) they can only develop in water.

In the calm atmosphere under albizzias the rubber leaves are not blown up, nor their under sides wetted. Conditions are not favourable for attack. Examination of Hevea leaves in sheltered places will show that even after heavy rains the undersides are dry, except for exudation from hydathodes.

During a cycle of wet seasons Phytopthora leaf-fall is a factor in production not to be neglected even in Ceylon. In 1914 and 1925 most low country estates were stripped nearly bare.

Subsequent regular visits to India have confirmed these observations. Apart from a few trees which appear to be genetically resistant to the disease those with the best foliage are to be seen under or around overtopping albizzias.

In 1926 the writer assumed the " visiting " of a semi-dry zone estate of which some 600 acres had been practically abandoned, principally owing to labour difficulties consequent on malaria. In this portion the foliage was sickly, but there

were two where it was markedly healthy. One was where the trees were very densely planted and had not been thinned out, the other, and better, was where there were still a comparatively large number of albizzias. Elsewhere the albizzias had been ringed or uprooted.

In the same year the writer, with Mr. C. E. A. Dias, visited Djasingha Estate in Java. This enormous estate was a concession given by Governor Raffles some 100 years ago. Much of the land had been in many products, cultivated in the older ways, which caused great soil losses. On one portion an extremely valuable soil rejuvenation experiment was being carried out. A thoroughly " washed out " field of poor rubber had been selectively thinned in order to establish albizzias. These had, at time of visit, about reached the average height of the trees, but already the improvement in the rubber foliage was marked and easily distinguishable from that of a neighbouring field.

In sight from this bungalow there is a small property of 135 acres which the writer now manages. It was planted in 1917/18 on a hog-backed hill. Clean weeding and burning of weeds was regularly done. When the writer returned to planting in 1919 these " burnt offerings " could be seen on most dry afternoons. The soil got redder and the trees looked more unhealthy every year until they struggled into the bearing stage. About one-third along this hog-back some thirty albizzias were planted and allowed to grow. The estate has been under observation for the last sixteen years and there can be no question that this is the best part, one might say the only really good part of it. When the writer, comparatively recently, assumed management a yield census was taken and it was found that the average of the trees under and close to the albizzias was double the rest. Various experienced planters have visited the estate and all have been impressed with the superior growth and health of the trees and the better soil.

CONCLUSION

All wet zone tropical forests are mainly evergreen, but Hevea is deciduous. Under deciduous trees, which are not primarily adapted to the conservation of tropical soils, we are attempting to remedy the defect by planting ground or bushy covers. Were such a combination suitable for rain forest tropical conditions one might expect to find somewhat similar conditions prevailing in some part of the tropical zone. No such cases are known. We are, in fact, beginning at the wrong end, and, whatever may be, and un-

doubtedly are, the advantages of ground or bushy covers, we cannot hope to emulate true wet zone forest conditions until the land carries at least a fair compromise of evergreen trees.

2. The ideal would be a working proportion of evergreen nitrogenous trees of economic value. We know of none which fulfil these requirements.

3. The alternative is a quick growing leguminous tree which will overtop the rubber and last approximately as long as the probable economic life of a stand of rubber of up-to-date commercial genetic value.

4. *Albizzia moluccana* appears to meet these requirements better than any other known tree. It is easy to establish in clearings and confers special benefits on young trees. Its establishment in old rubber may be difficult, but by removal of poor yielders, and perhaps some pollarding, it might be possible to grow some 10 to 20 per acre. It is contended that this might help to tide over old rubber during the period of replanting and to improve the soil for future use.