PATHOLOGICAL PROBLEMS

By

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Though many diseases and pests of the tea bush have been recorded in Ceylon in past years, the majority are of minor economic importance. Occasionally, however, when environmental conditions are suitable, outbreaks of any particular disease or pest may cause anxiety.

The disastrous effect of the fungus causing the coffee leaf disease, and the fungus causing the disease of potatoes which was responsible for the great famine a century ago bring to mind the importance of diseases, particularly those which effect foliage. The survival of tea would be doubtful if the blister blight fungus proved able to attack mature foliage instead of young leaf only. The mature pre-tipping leaf which partly fulfils the functions of food manufacture must be held by the bush through its cycle and any disease or pest which may cause it to defoliate or damage has to be controlled. One such disease is caused by the fungus *Calonectria theae* better known to most of you as the Cercosporella leaf disease of tea. That disease has been particularly widespread this year especially in areas where *Acacia decurrens* is grown as a shade tree or wind belt. The fungus, may attack mature and young tea leaves through the breathing pores or stomata and, may cause heavy defoliation of maintenance leaf when weather conditions favourable to its spread continue for a fairly long period. The type of weather which favours blister blight also favours the Cercosporella disease. When both diseases occur together the result may well be disastrous to the tea bush.

Two forms of Cercosporella attack are known on tea. Spotting of the young flush is known on a number of estates but in such cases defoliation does not occur except where *Acacia decurrens* is grown, and mist persists for a fairly long period. Where acacias abound, their small leaflets, on defoliation, often fall on and adhere to the older tea leaves and, if the acacia leaflet is infected, hyphae grow out from it and increase the adhesion. Under these circumstances a large blotch is formed on the tea leaf and spores become abundant. The tea bush then reacts by casting off the leaf. This, in my opinion, is another example of attack from a "food base" such as occurs with poria.

The problem that confronts the planter is whether the good derived from acacias is greater than the evil of the disease. On that I cannot generalise. The Nuwara Eliya estates and many others grow acacias extensively but have never had serious trouble from Cercosporella though it is always possible to find the disease on the tea. It is very likely that the weather conditions this year have favoured the disease and it is also probable that for many years more the same conditions may not arise. Careful observation can only supply the answer but in the meantime it is advisable to grow other types of shade trees if the planting of acacias can be avoided.

After a lapse of about 25 years *Corticium invisum*, the cause of black rot of tea, was observed on three upcountry estates. Its appearance, after this long period, does not necessarily mean that it has lain dormant for so long. It probably existed unnoticed in a mild form but the somewhat prolonged south west monsoon this year may have created conditions more favourable to its spread. What has to be considered, however, is that the disease is known to cause extensive damage in North India, where, on a number of estates, routine spraying with fungicides is undertaken as a control measure against its spread.

The disease, as its name implies, causes the young leaves to blacken, and rot. Only patches of the older leaf usually become infected, though if weather conditions are suitable, complete destruction of such leaves is possible. Many of the leaves fall off but some remain suspended from the stem in a more or less vertical position. The fungus forms its spores on the undersurface of apparently healthy leaves where it may be seen, with a simple lens, as a fine powdery film.

I am indebted to the Superintendent of one of the estates concerned for the census of diseased bushes in his fields.

"2,560 individual diseased bushes have been noticed scattered haphazared throughout the division. 10 patches have been marked. Affected bushes range in number from 10 to 360 while the total number of diseased bushes in patches is 1,280." The affected bushes and a ring of healthy tea were pruned, the prunings burnt and the frames sprayed with three heavy applications of copper fungicide to which the fungus is particularly susceptible. Whether the disease will make its appearance during the next rainy season yet remains to be seen.

Corticium invisum forms minute sclerotia or specialised parts of compact fungus in the primary bark of stems and in cracks in the larger branches. These sclerotia resist desiccation for fairly considerable periods and are probably the main means of survival from one season to the next. When weather conditions are favourable the sclerotia begin to grow; fine strands of fungus mycelium grow out from it and extend along the stems and on to the leaves where the disease symptoms appear.

The poria root disease of tea was chosen as the subject of a conference address in 1937. At that time the disease was considered of major economic importance and control measures which were the outcome of experimental work on St. Coombs were advocated. We advised the removal and destruction by fire, of all dead and diseased bushes *together with* one complete row of healthy tea bushes on the perimeter of each patch. If that work is done satisfactorily and if all pieces of infected roots are collected, poria can be exterminated. But in many cases the method did not meet with approval as, it was argued, a number of high yielding bushes were sacrificed in each diseased patch. The policy of removing only dead bushes therefore continued with the result that the fungus slowly but surely took its ever increasing toll. In 10 years the ring of healthy tea no longer existed while 3 or 4 other rows had become infected too. The patch became alarmingly large and the fungus was still active. What could have been a sheet of tea, if correct control measures were adopted, was now a bald patch on the landscape. In the meantime new centres of infection had sprung up, arising from bits of diseased roots dropped along foot paths and short cuts by labourers.

On one estate which I visited recently removals until 1946 were confined to dead bushes only with the result that the patches had extended alarmingly in size. At this late stage the recommended control measures were adopted but were then, of necessity, very costly. Bush removals and the costs involved are as follows :—

Year.	Bush Removals.	Costs.
		Rs.
1946	10,459	2,339
1947	7,079	2,717
1948	30,693	16,280
1949	42,530	20,989
1950 (To Sept.)	32,794	20,258
	123,555	62,583

At the estimated stand of 3,000 bushes to an acre approximately 39 acres now lie fallow.

Many low-country planters have been faced with the problem of root diseases in areas being replanted from rubber to tea. The popular belief in planting circles is that the poisoning of rubber trees with sodium arsenite removes the danger of the subsequent spread of root disease fungi, and that poisoning kills the fungus in infected roots. Nothing is further from the truth. Sodium arsenite travels only a short distance on either side of the injection point. It kills the tree quickly and with death the root system is invaded by saprophytic fungi which break down the cell tissues to make them untenable to parasitic forms. If sodium arsenite did enter the whole plant system, no fungus either saprophyte or parasite could use those tissues. What is poisonous to one is just as toxic to the other.

What then is the ideal to aim at? Undoubtedly it is to kill the root system of the shade or jungle tree as fast as possible to permit its invasion with saprophytic fungi before the tree is felled and large cuts exposed to spore infections by parasitic forms. Ring-barking to kill the root system prior to felling operations is the obvious answer. Trees known to be infected with root disease fungi must, however, be singled out and all diseased roots removed and destroyed in the usual manner.

Nematodes or eelworms are a group of very minute animals that inhabit soil. Many thousands of species are known to exist, the great majority being saprophytic forms which feed on bacteria and other soft foods but are incapable of causing direct damage to plants. Of the plant parasitic species two are known as pests on tea and green manures.

The better known plant parasitic species is the root knot eelworm which lives in the roots of tea seedlings, Tephrosias and dadaps, and in which it forms the characteristic knots or galls. In the larval or eel-like stage the worm is very active but when entry into a susceptible root is achieved, the worms settle down to a sedentary life to complete their life cycle and the propagation of their kind.

In early stages of growth, tea seedlings are very susceptible to infestation but with age, the plant appears to acquire immunity or the worm for some other unknown reason leaves the rootlets. On the other hand we have evidence that the root knot eelworm is a pest of mature tea in three estates in the upcountry area. There are, therefore, at least two races of the root knot eelworm, one which infests adult tea roots and the other which finds the same roots distasteful. If the so-called "adult tea" race of worms has sprung up from the race which is known to attack tea seedlings, Tephrosias and dadaps, there is then the possibility that other estates may become similarly affected.

To lessen the probability of this happening, the root knot eelworm population in the soil must be kept at a low level. Cover crops susceptible to the eelworm therefore constitute a danger. Changes must be rung periodically by a rotation of green manures as it is impossible to change the permanent crop tea. Dadaps if heavily infested must be replanted with albizzias or gliricidias if the estate is situated at an elevation low enough to grow the latter. Crotalarias should replace tephrosias. When the eelworm population in the soil is starved out for lack of a susceptible host tephrosias may then again be planted.

The other eelworm pest *Pratylenchus pratensis*, or the meadow eelworm, is now known to occur in about fifty tea plantations. The distribution is alarmingly wide, as affected estates are situated in most of the large upcountry tea growing districts. The degree of infestation of course varies from estate to estate; in some estates the problem is acute while in others the pest occurs in limited areas though its spread is gradually extending.

The total extermination of the pest in tea plantations by chemical or other measures is impracticable. No treatment can be effective unless a 100 per cent kill is possible, as a few eelworms surviving treatment can build up to gigantic numbers over a short period of time provided a susceptible crop is planted again.

Replanting or supplying with material grown from tea seed usually ends in failure, as the heavy meadow eelworm population in the soil kills the feeding roots as often as they are formed. Very encouraging results have, however, been obtained with supplies of vegetatively propagated material obtained from vigorously growing bushes in infested fields. We have suggested, and as a matter of fact the suggestions are in practice on more than one estate, the planting of this so-called resistant clonal material as a possible means of control. The proof of resistance has to be over a long period as plants must grow in infested areas for many years before success can be definitely established. The problem certainly teems with difficulties but at present I can see no easy form of control.

In the meantime the infested fields have to be kept at an economic level of productivity as heavy infestation with the meadow eelworm results in the destruction of feeding roots. In consequence foliage in direct communication with those roots die too. This continual process of death and new growth must inevitably be at the expense of stored food reserves; bush starvation is therefore the ultimate result.

It is possible by agricultural practices to keep eelworm populations in the soil at a low level and thereby lessen severe root destruction. Among soil fungi are a number of species highly specialised for trapping nematodes. The trapped eelworm rarely escapes, and its body is used by the fungus as food. A parasitic eelworm is as likely to be caught in a trap as a non-parasitic species but it should be clearly understood that the parasitic species runs this risk only at the time it is moving through soil.

The number of eelworm consuming fungi in the soil depends to a large extent upon the size of the eelworm population, the greater the number of nematodes, the greater the number of fungi which can live on them. It therefore becomes necessary to increase the population of the many species of non-parasitic nematodes by incorporating decaying organic matter into the soil. This is best done a short time prior to pruning as with the removal of foliage the bush's feeding roots die too, freeing into the soil a large percentage of their parasitic eelworms. Until new rootlets form, the eelworms are free-living, and in their wanderings through the soil are far more liable to come in contact with the trap fungi than they would if rootlets are in abundance during normal growth. Applications of organic material must be reasonably heavy — 10 to 20 tons per acre prior to pruning. After that only occasional applications will be necessary until the subsequent pruning operation.

If the fight is against the root-knot eelworm, crops immune to attack must be planted. In the case of the meadow eelworm, however, green manures whether they are susceptible or not should be grown at maximum intensity to supply the loppings for incorporation into the soil. If non-susceptible green manures grow well, undoubtedly they are preferable to crops which support the pest but the main criterion must be a bush crop which gives a large amount of loppings.