

WHAT IS THE DIPLODIA ROOT DISEASE OF TEA ?

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Diplodia root diseases of tea have been recorded from India, Ceylon, Java and Nyasaland. The symptoms, however, do not appear to be alike in all countries; the only character common to them all is the presence of a particular fungus, *Botryodiplodia theobromae*, on the roots of affected plants, usually, after death.

Botryodiplodia theobromae is a common fungus throughout the tropics, where it is found in forest and grassland as well as in arable land. In general, it is saprophytic, i.e., it feeds on dead tissues, though there is some evidence of its parasitism on certain plants such as cacao, sugarcane and Hevea rubber. On tea also there is some evidence of its parasitism, but the fungus is so very prevalent that were it able to attack healthy tea bushes indiscriminately, few would survive.

When such a common fungus is constantly associated with diseased bushes, there must always be some doubt that it is the cause of the disease until definite experimental proof is produced.

It will be admitted that if water is withheld from the roots of a tea bush, that bush will ultimately die just as a neglected pot plant will die for lack of water. Tea bushes which have died in Ceylon under conditions such as would warrant a conclusion that they had died of drought, invariably, in the writer's experience, bear the fungus *Botryodiplodia theobromae* abundantly on the dead roots. The fungus is probably there by accident owing to its ubiquity, and its presence cannot be regarded as evidence that the fungus played any part in causing the death of the bush. The fungus may possibly have hastened the death of the roots, but, even in that case, it can be regarded as of little economic importance. Such deaths are best attributed directly to drought.

When bushes die from an unknown cause and the roots are found to be constantly infected by the same fungus, *Botryodiplodia theobromae*, there is no more justification, from that fact alone, for the conclusion that the fungus caused their deaths, than there is for drawing a similar conclusion in the above-mentioned cases of drought. At the same time it would be unwise to conclude that because a fungus is a very common saprophyte it, therefore, cannot be parasitic under any conditions. As already stated, there is some evidence that *Botryodiplodia theobromae* becomes parasitic on certain host plants, but where it is known to cause damage it is either a wound parasite or a follower of some other disease.

Bearing these points in mind, it is not very surprising that diseases of the tea bush, the causes of which are obscure and which exhibit very different external symptoms, have been ascribed to *Diplodia* owing to the constant presence of that particular fungus on the roots. Thus, there is not one *Diplodia* root disease of tea but many. To call them all by one name, whether that name be *Diplodia* or internal root disease, is not helpful to the practical planter whatever it may be to the mycologist. So long as the name *Diplodia* disease of tea is retained, it should be regarded as a group of obscure diseases. As each disease is investigated and its true cause ascertained, it will be necessary to give distinctive names to the individual diseases.

The writer (1 and 2) after investigating the common *Diplodia* tea root disease in Ceylon, viz., that in which apparently healthy, mature tea bushes die after pruning, arrived at the conclusion that the deaths were a direct result of a deficiency of internal food reserves at the time of pruning. In every case examined, the roots were destitute of starch. Tunstall (7) does not find the same absence of starch in *Diplodia* diseased tea bushes in North-East India. He states "Bushes have been frequently observed with roots and trunk so badly attacked by the *Diplodia* fungus that the wood was darkened throughout yet containing abundant starch. Such bushes produce new shoots after pruning but after the latter had attained some length they died back." The writer has also seen *Diplodia* infected roots which contained abundant starch, but these were obtained from a bush in full leaf which had died of drought, not from a bush affected by the common Ceylon *Diplodia* disease.

No claim has been made that deaths from all so-called *Diplodia* root diseases are the result of deficiencies of internal reserves. That conclusion applies to one of the *Diplodia* diseases only, namely the common Ceylon form which is always associated with pruning. This form of *Diplodia* disease now requires a distinctive name to distinguish it from the other *Diplodia* root diseases of tea.

It is not surprising that Tunstall should obtain different results if his investigations were carried out on a different form of *Diplodia* root disease of tea. That such is possibly the case is evident from the published descriptions of the disease as it occurs in North-East India.

The first record of a *Diplodia* root disease of tea was made by Watt and Mann (8) from the Bishnath district of Assam. The disease occurred on young plants three or four years old, growing on grassland. "There is little to show on the surface of the root as to what is the cause of the death of the plants. The leaves of the plant take on a yellow appearance, in which the network of the veins is very

prominently seen (an appearance easily recognised after a little practice), and then they begin gradually to fall off and, branch by branch, the bush dies."

The disease here described has definite symptoms; it is a disease of young plants which have never been plucked and which exhibit peculiar leaf characters.

A more recent account of the Diplodia disease in North-East India is given by Tunstall (7):—

"The symptoms of the disease are not the same in all cases. A plant may be affected for many months and yet continue to look healthy. Suddenly, without any warning, the bush dies with all its leaves attached as though it had been struck by lightning. In other cases, the leaves may take on a yellow appearance and the veins darken a little in colour, defoliation then occurs gradually and the bush dies branch by branch."

"The most serious losses, caused by the fungus, are on young tea, *i.e.*, plants up to three years of age. It frequently happens that at the beginning of the season when the early rains have fallen, here and there in a new clearance an apparently healthy plant dies suddenly without any apparent reason. Others, at the same time, begin to look sickly The same sort of thing happens on all classes of soil, but is most frequent on coarse, sandy soils subject to drought. Mature and old tea plants on such soils also die in a similar manner in the rainy season succeeding a long period of dry weather."

This description includes that given by Watt and Mann, but has been extended to include another Diplodia disease of tea or an extension of the same disease to old tea. It would appear that the disease in North-East India occurs principally on young tea and is more intimately associated with drought conditions than with pruning, though "for some reason or other pruning accelerates the last stage (of the disease) and the plants die about six weeks after pruning."

The first account of a Diplodia disease of tea bushes in Ceylon was given by Petch (4) in October 1910. A fuller description (5) was published in 1923 from which the following extracts are taken:—

"In its most common form, this root disease only comes into prominence after pruning. Sometimes the pruned bushes, which may have appeared perfectly healthy before pruning, fail to produce any new shoots and die off completely. In other cases, the green shoots grow to a length of about six or eight inches and then begin to die. Their leaves become mottled with yellow, and then turn black, the latter change occurring first at the tip, or along the edges and ultimately extending over the whole leaf Finally, the leaves fall and the whole shoot becomes dead and black down to its base. This condition may begin on one or more of the main

branches, and gradually extend over the whole bush, or it may remain confined to one branch. In the former case the whole bush dies, in the latter only the branch affected; and all intermediate stages may be found. The disease usually appears from six weeks to three months after pruning."

"In Ceylon, this disease is commonest on old tea, but is by no means confined to that. Several cases have occurred on tea after the first pruning, and on badly affected estates it has killed out nursery plants."

From the first sentence of the foregoing quotations it would appear that there is a less common form of this disease in Ceylon which is not associated with pruning, *i.e.*, in which the fungus attacks the bush while in full leaf. If so, it is possibly referred to by Petch in the following sentences: "When *Albizzias* (*Albizzia moluccana*), planted through tea, are allowed to grow to a large size and are then ringed or cut down, and the stumps left to decay *in situ*, root disease frequently attacks the surrounding tea bushes. In some instances, this is due to *Ustilina zonata*, but when a large number of bushes die, twenty or more, round an *Albizzia* stump, the cause is usually *Botryodiplodia*. The fungus develops on the dying *Albizzia* stump, and its spores subsequently infect the neighbouring tea." This form of the *Diplodia* disease has been very rare in Ceylon in recent years, and has not come within the writer's experience.

In *old tea*, after pruning, the disease occurs mainly at elevations below 2000 feet on all types of soils. Bushes which are partially affected, *i.e.*, those which successfully produce new shoots on one or more of the main branches, develop no further symptoms and exhibit normal growth till they are next pruned. In other words, the disease is only evident immediately after pruning. In *young tea* which has never been plucked, the disease is not confined to low elevations; in fact, it is best known to the writer at higher elevations, and the cases he has had under observation do not develop normally when they survive their first pruning. The bushes have a general sickly appearance though the symptoms are not, in all cases, identical.

It is possible therefore to divide the *Diplodia* disease, as it is described by Petch from Ceylon, into three forms based on their general symptoms:—

1. In old tea after pruning—the commonest form.
2. In young tea after its first pruning and in nursery plants.
3. In tea in full leaf—rare.

It may be possible later to distinguish the disease as it occurs in nursery plants from that which develops after young tea is first pruned in the field, but for the purpose of this article the division of form 2 is unnecessary.

The symptoms of the common form of *Diplodia* root disease in Ceylon differ markedly from those exhibited by the disease in North-East India. The North-East India disease approximates to that known on young tea in Ceylon, but there is some doubt that the two are identical. Leaf symptoms characteristic of the Indian disease have not been recorded on young tea in Ceylon, though they have been observed on bushes affected by the disease or group of diseases known as Witches' Broom.

Diplodia root diseases of tea are also known in the Dutch East Indies and in Nyasaland. Steinmann (6) reports that this root disease was first noticed in Java in November, 1926, after a very severe drought, when it caused very severe losses in nursery plants and young and old tea.

Of the disease in Nyasaland, Dr. Butler (3) writes "Cases of the root disease caused by this fungus (*Botryodiplodia theobromae*) were not common in Nyasaland, except in young tea, during the period of my visit. Mature dead bushes were never found to have more than an occasional root infected . . . The only instances in which bushes appeared to have been killed by *Botryodiplodia theobromae* were in the first and second year after planting out and such attacks were always sporadic."

This brief review suggests the possibility that the *Diplodia* or internal root disease of tea is not a simple specific disease, and that diseases with probably different causes have been classified as *Diplodia* diseases, mainly because of the constant presence of the fungus *Botryodiplodia theobromae* on their roots. That fungus may be there as a causative factor or merely accidentally as a common saprophyte. The exact meaning of its presence has to be determined for each individual disease before its true importance can be ascertained.

This view is also suggested by Butler, who in a report on an obscure tea disease in Nyasaland (3)—a disease which he regards as "unquestionably one of the most serious diseases to which the tea bush is liable"—points out that the above ground symptoms are somewhat similar to those of the *Diplodia* disease seen by him in Assam in 1902, and described by Watt and Mann. He also suggests the possibility that the disease occurs in the East but has been confused with the effects of *Diplodia*.

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