A PRELIMINARY NOTE ON CACAO DISEASE IN THE DUMBARA VALLEY, 1933

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IT is a common experience in Ceylon for a certain number of cacao trees to die suddenly in the wet season. The causes of the deaths of the trees have not always been clear but claret-coloured canker (*Phytophthora palmivora*) and root-diseases have been presumed to be mainly responsible while the rather vaguely-used term 'die-back' has been applied to others. This year the increase in the number of deaths, particularly from May until August, has been somewhat alarming and, in consequence, cacao disease has received the attention of officers of the Department of Agriculture. Numerous estates and village gardens have been visited and, although the investigation is not yet completed, sufficient information has been obtained to justify this preliminary note.

It should be made clear at the outset that, in the opinion of the writer, the increase in the number of casualties in cacao estates and gardens this year has not been due to the incidence of a new disease but rather to a combination of circumstances which have favoured the activity of disease existent in Ceylon for many years. With modern estate practice, the number of deaths caused by root diseases is small and there has been no marked increase this year. Canker (*Phytophthora palmivora*) has been very common, since the prolonged wet weather has favoured its spread. The number of deaths which can be attributed directly to canker is however, not great and as this disease is well known to all cacao-growers in Ceylon it is not proposed to make here more than a passing reference. The disease which has been found to be the cause in the majority of deaths of trees is separate and distinct from root disease and canker and is discussed below.

SYMPTOMS OF THE DISEASE

The disease is usually first observed through its effect on the foliage. All leaves of the whole or of one or more of the main branches of an apparently healthy tree suddenly show a

distinct change in colour. The whole of the foliage of the infected tree or part of a tree changes from the normal green colour and assumes an unhealthy pale sage green colour and this change is followed within a period of three to five days by a wilting of the leaves. The leaves dry up and eventually turn brown but remain attached to the branches. About three weeks after the first observed change of colour the foliage is completely dead. Such trees with all the leaves dead and attached to the branches present a striking appearance and can be readily distinguished from surrounding healthy trees. At this stage all the above-ground parts of affected trees are dead although the roots are usually still alive and unaffected. The disease subsequently spreads down to and kills the roots.

The changes in the foliage of diseased trees are preceded and accompanied by changes in the cortex which are not very obvious externally. A little before or at the same time as the first colour change in the leaves, the stems of diseased trees are attacked by small boring beetles (*Xyleborus* sp.); these beetles are closely allied to the shot-hole borers of tea. The presence of the beetles can be detected by the worm-like casts of wood dust which are extruded from the galleries. If the outer bark is cut away, it can be seen that the cortex below is slightly discoloured and is somewhat more buff or brown than the yellowish or reddish cortex of a healthy tree. The cortex is at this stage still moist, but not excessively so, and has a distinctly fermented smell. It is thought that this fermented smell is that which attracts the borers since, although diseased trees may contain many borers, surrounding healthy trees are not attacked. If the borers were responsible for the disease this discrimination would be inexplicable. This point has been stressed since it has been suggested to the writer by more than one layman that the borers are responsible for the disease.

The first change in colour in the cortex is followed rapidly by a further change and the cortex turns brown and dries so that, by the time the leaves have turned brown, the cortex is also dry and brown. The discoloured cortex is usually situated on the main stem within eight feet of the ground. It is not localized as is canker and may extend all round the stem or along one side of it. It spreads rapidly upwards and, by the time the leaves turn brown, the discoloured cortex may extend for six feet or more. The occurrence of fungi in the diseased cortex is discussed below. The roots remain healthy until after the symptoms described above have been displayed for some time.

The disease differs from claret-coloured canker in the rapidity of its action, in the absence of any exudation from diseased tissue and the subsequent external discoloration of the bark, in the extent of the diseased cortex and in the absence of the typical claret-colour which appears in cankered cortex.

In single-stemmed trees the disease usually affects the whole tree, although in trees where low branching has taken place, one main branch only may be affected. In double-stemmed trees, it often happens that one half of the tree is killed while the other half is unaffected. The disease usually affects old trees but not invariably. Diseased trees occur singly and not in groups. There has been no indication that either healthy or ill-nourished trees are most susceptible, nor has any variety been found to be resistant to the disease. In one estate in the Dumbara Valley containing about 300 acres of cacao it is reported that 2,000 dead trees were cut out during the three months from June to August, 1933. Of these a large proportion was killed by the disease under discussion.

DISCUSSION

The disease is attributed by some experienced planters directly to the unusually wet weather. Figures obtained from two estates have indicated that the rainfall has been exceptional during the past year. In one, the rainfall for the year ending 30th June, 1933, was 110·6 inches as against an average annual rainfall of 72 inches, while in the other, the rainfall for the year ending 31st July, 1933, was 115·6 inches as against an average of 86 inches: at Peradeniya, where the disease has also occurred, the rainfall for the same period was 110 inches as against an average of 89 inches, the increase occurring since January, 1933.

An observation which may be significant may be made here. During May, 1933, severe floods occurred and areas of cacao not usually subject to flooding were submerged for one or two days. In such areas in Peradeniya the trees subsequently died and displayed symptoms very similar to those under discussion. The leaves became discoloured and wilted and at the time of examination the cortex of both stems and roots was markedly discoloured. Borers had attacked the stems of these trees. Water-logged conditions are, however, not necessary for the incidence of the disease. Diseased trees have been observed on well-drained soils and on the sides of hills. Isolated trees are affected by the disease and this fact indicates although flooding may cause the exhibition of similar symptoms, some other cause of the disease must be sought.

Attempts have been made to determine if the occurrence of the disease has been more serious in the past in wet years than in dry years. The only figures that are available are those of the total number of dead trees uprooted on certain estates. Although the figures are not definite, there appears to have been some correlation between the rainfall, especially in the first half of the year, and the number of uprooted trees. Looking back through the official records, it is obvious that more interest has been taken in disease in cacao during wet years, *e.g.* 1913 and 1923, than in others and from this it may be inferred that cacao disease was more prevalent in those years than in others. Such evidence is unsatisfactory and it would appear that no reliable data from the past are available. The disease does not appear to be caused directly by any soil condition. Its occurrence, wide-spread throughout the main cacao growing areas of Ceylon, on individuals rather than on groups of trees tends to indicate that it is not a highly infectious disease. The nature of the disease does, however, suggest that a parasitic organism may be the cause and experiments are in progress to determine if this is so. The disease is a stem disease and numerous isolations have been made from diseased cortex.

In the early stages of the disease, when the first attack by borers indicates that some change has taken place in the cortex, there is no sign of a parasitic organism. When discoloration extends and the cortex dies fungi have been observed in the tissues. *Nectria striatospora* is found on the dead bark of all diseased trees. The fungi appears first as white or pink pustules a little larger than a pin's head which burst through small ruptures in the bark. Later the perfect stage of the fungus develops as clusters of crimson fruit bodies. The fruit clusters are small and rarely exceed 0·1 inch in diameter. *Nectria striatospora* was considered to be the cause of claret-coloured canker by Carruthers in 1898 but later investigators have disproved this and have concluded that the fungus is saprophytic. It occurs commonly on the bark of dead cacao stems or branches and is not confined to diseased trees.

Within the dead cortex of diseased stems and between the cortex and the wood, strands of mycelium of a fungus occur regularly. The strands are black externally and white internally, roughly cylindrical within the tissues of the cortex but somewhat flattened between the cortex and the wood. They are about 1 mm. in width and branch infrequently. The presence of

these strands in diseased cacao cortex has been remarked by previous investigators but hitherto no attempt to identify the fungus has been recorded.

Inoculation experiments are in progress to determine if pure cultures of these fungi are capable of causing the disease. It is always possible that, in a season so wet as the current season, fungi which are normally incapable of causing a serious disease may find conditions suitable for their rapid progress as parasites.

SUMMARY

Cacao disease has been unusually prevalent in the Dumbara Valley during the months May to August, 1933. While claret-coloured canker has been more severe than usual owing to the very wet season, the majority of the deaths of trees that have occurred are attributed to a form of stem disease which causes the trees to wilt and die rapidly.

The cause of the disease is not known but there is some evidence to show that its severity is correlated with the unusually wet weather experienced this year. The disease is thought to be one that has existed in Ceylon for a long time. Further investigation of the disease is in progress and it is hoped to issue more information when further knowledge has been gained.