Contributions from the
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A Note on Cover Crops in Relation to Root Diseases of Rubber.

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SINCE the introduction of cover crops as a general measure on most Rubber estates in Ceylon, the question has arisen as to how far these crops will favour the spread of root disease.

It is not necessary here to consider in any detail the conflicting views held as to the causation of root disease, but we must at once distinguish between the fungus *Rhizoctonia bataticola* on the one hand, and the fungi commonly associated with root disease such as Fomes (*lignosus* and *lamaoensis*), Poria and Ustulina on the other. Our present knowledge leads us to believe that Rhizoctonia does not spread through the soil by contact, whereas the other fungi do. It would appear, therefore, that the occurrence of the former fungus has no bearing on the present subject except in so far as its presence on a cover plant may be necessary before that plant is attacked by Fomes, Poria, or Ustulina. Rhizoctonia has so far been reported by Small as occurring on *Tephrosia candida*, *Crotalaria* sp. *Desmodium heterocarpum*, and *Clitoria cajanifolia*, of the commonly used covers. Whether the fungi which have in the past been supposed to cause root disease are primarily responsible or not, it seems almost certain that they are at least secondary parasites and hasten the death of the trees which they attack. As such they are of importance to the practical planter and must be guarded against. In the following notes, therefore, these fungi will be referred to as causing root disease of Hevea without however assuming that they are the primary causative agents.

We may distinguish between:—

(1) Erect Covers,

(2) Creeping Covers.

(1) **Erect Covers.**—These include such species as *Tephrosia candida*, *Crotalaria* sp:, *Clitoria cajanifolia*, etc. Most of these erect covers become woody after one or two years' growth, and are then liable to be attacked by the fungi which cause root disease of Hevea.

It is clear that a crop interplanted with Rubber and susceptible to attack by any of the root fungi to which the Rubber is liable, will aid in the spread of the fungus if this spreads by contact. A good example of this has recently been under the writer's observation. An old tea field, about 60 acres in extent, had been cleared and planted with Rubber about 3 years ago. The whole area was planted up with *Crotalaria* sp. and portions with *Dolichos hosei* (Vigna). The tea stumps have not been removed, and in February, 1928, a considerable amount of the fungus *Fomes lignosus* was found on the Rubber and Crotalaria. The fungus occurred in patches throughout the whole area and had apparently been responsible for the death of many Rubber saplings and Crotalaria plants. Many cases were noted of *Fomes mycelium* passing from roots of Crotalaria to those of the Rubber and *vice versa*. There can be little doubt that the presence of the Crotalaria among the Rubber had aided the spread of the Fomes.

Tephrosia candida, when old and woody, may be attacked by *Poria hypobrunnea*, while the writer has also found *Fomes lignosus* on this cover. *Fomes lamaoensis*, the fungus causing Brown Root disease, has been found on Crotalaria sp. in association with *Fomes lignosus*, *Diplodia*, and *Rhizoctonia batatticola*. It is probable that associations of these fungi with other species of cover crops will be noticed as the use of cover crops is extended.

The obvious corollary to the fact that most erect covers become liable to attack by root disease fungi when they become woody is that a time limit must be set to their growth. It is usually considered that *Tephrosia candida* should be taken up after two years while a corresponding limit may be set to the age of other covers of a similar nature. It is not sufficient merely to cut the plants down: the stumps must be extracted and burnt. If left in the ground they may be attacked by Fomes, Poria or Ustulina and become centres of further infection.

(2) **Creeping Covers.**—Most of the observations made in connection with the relation of creeping cover crops to root disease refer to *Dolichos hosei* (*Vigna oligosperma*), though the conclusions arrived at are probably equally applicable to such species as *Centrosema pubescens*, *Calapogonium mucunoides*, etc.

Whereas in the case of erect covers the spread of root disease may be favoured by the cover plants themselves being liable to the disease, in the case of creeping covers the effect is more indirect though possibly more marked. As far as is known none of the creeping covers grown under Rubber are parasitised by any of the fungi causing root disease of Hevea.

Probably the most important means by which the growth of Vigna influences the spread of root disease is in causing moist conditions in the surface layers of the soil, as such conditions favour the growth and spread of the mycelia of the fungi which cause disease. A striking instance of this was recently observed by the writer. Two or three trees growing in a rocky ravine were seen to show symptoms of root disease in the aerial portions. The ground was carrying a luxurious growth of Vigna which covered up many rocks and boulders, and on rolling this back the presence of *Fomes lignosus* was disclosed. The fungus was apparently in a very active condition mainly due to the moist conditions under the Vigna. The mycelium was growing freely over stones and boulders which, had they been exposed to the sun and air, would have offered no medium for the spread of the fungus. The apparent source of infection was a rotten jungle log, and the fungus had spread outwards in all directions to the extent of about ½ acre. Only two or three trees in the middle of the area showed in their foliage definite symptoms of root disease; this indicates the rapidity with which the fungus had spread.

Another phenomenon which was noted on the above mentioned area, and which has been observed on other estates is the growth of mycelial strands of Fomes along the older runners of the Vigna. The Fomes does not appear in any way to harm the Vigna, but merely spreads along it. A case has been seen of a tree being infected with *Fomes lignosus* at the collar, the mycelium having reached the tree along the Vigna. The lateral roots, where they joined the collar, were quite free from the fungus, so that the mycelium had spread more quickly along the Vigna than underground.

On one estate young immature fructification of *Fomes lignosus* were found growing on a tangled mass of dead Vigna runners, and it would appear, therefore, that although Fomes is not parasitic on Vigna it can live as a saprophyte on the dead tissues. Consequently where there is a well established cover of Vigna there is a suitable medium for the growth of Fomes.

An indirect means by which Vigna may aid in the spread of root disease is by concealing it, so that its detection is rendered more difficult. A tree was recently seen on the trunk of which fructifications of *Fomes lignosus* were growing up to a height of nearly a foot. These had been completely concealed by a thick cover of Vigna as also had the mycelium on the lateral roots near the collar. The tree was nearly dead and should have been noticed earlier, but it is probable that had the Vigna not been present the disease would have been detected at the first appearance of a fructification. This difficulty is easily overcome by keeping a circular area of about 8 ft. in diameter round every tree clear of Vigna. The detection of root disease, and more especially of Ustulina collar rot, is thereby made easier. Once the circle has been cleared it can easily be kept clean by the scrappers or tappers.

In conclusion it should be understood that the assistance in the spread of root disease fungi by cover crops is not in itself an argument against growing them, and it would be a mistake for an estate to deny itself the undoubted benefits to be derived from these crops because of the possible danger from root disease. It is, however, recommended that cover crops, and in particular Vigna, should not be grown in areas known to be affected with root disease, and if already established they should be cleared away.