ORGANIC MATTER AND PARASITIC FUNGI

D. Mulder

When a disease or a parasite has established itself in a particular host, why does it not always increase until it eventually kills or smothers the host? On the one hand, the host often resists the disease with increasing force; and on the other, even parasites have their enemies. Even parasites have to struggle for their existence and the fact that they occur at all means that they have achieved some success in this struggle.

In Ceylon, it seems that Blister Blight has found a situation in which it can be more successful than in Assam. Such a situation is not uncommon for organisms that attack plants, when those plants are grown in new areas, where they have never occurred naturally. The conditions in the new areas may be unfavourable in some respects to particular plant species either in climate or in disease, unless the plants are helped by man. With extensive areas planted in one species—mono-cropping—the danger is increased of the balance between crop and environment breaking down, resulting in an epidemic. The help required from man to restore and maintain the balance may be great or small. It may often be most economical when man can enlist on his side the help of other organisms, as in the well known case of *Macrocentrus* parasitising Tea Tortrix.

There are various ways in which organisms can keep each other in check. Straight-forward swallowing occurs between animals and is the habit of eelworms, but amongst fungi and bacteria other more insidious ways of hindering each other's development prevail. Their action, known as antagonism, consists of the secretion of an organic chemical compound which hinders other organisms in their growth or even kills them. The modern pharmaceutical industry is partly dependent on these products; penicillin is one of them, and streptomycin another one. Their group name is antibiotics.

Although we cannot yet make much use of these compounds in the control of parasitic fungi on plants, we can indirectly profit from their production on the spot, by saprophytes in the soil. Some fungi combine an antagonistic action on their victims with a subsequent parasitic action. Others are only antagonistic. The antibiotics secreted by soil saprophytes affect not only other fungi in the soil but also parasitic fungi living on various parts of the plants growing on that soil. It has been found that several antibiotics are absorbed by the plant roots and, being transported throughout the plant, cause immunity to either bacterial or fungus diseases.

Antibiotics are mainly produced by fungi, actinomycetes, and bacteria. A great number of antibiotics are produced by actinomycetes. This group of primitive fungi consists mainly of saprophytes living on decaying organic matter in the soil. In plant-disease control, antibiotics derived from soil organisms have been used as sprays, dusts, dips, for injection into the plant, and for soil application.

I have to limit myself here to the last mentioned method of soil application in order to reach my ultimate aim—that is the control of Red Root Rot caused by

Plate 1. Left—Part of the root of a tea bush infected with *Poria hypolateritia*, dug up from an unfumigated plot and kept in a moist chamber. Note the abundant growth of white strands of *Poria* mycelium.

Right—Part of a root previously infected with *Poria* from a plot fumigated with D-D mixture and kept in a moist chamber. It shows the abundant growth of the mycelium of *Trichoderma viride*.

Poria hypolateritia. Although theoretically a direct soil application might be preferable, the trouble is that many of the antibiotics are also extremely costly to buy and are readily decomposed or otherwise inactivated in soil. Gliotoxin, for instance, produced by a soil fungus called *Trichoderma viride,* is decomposed in soil a few hours after application. This fungus is very common in tea soils in Ceylon, but depends on organic matter for its growth.

In view of this situation, we have not tried to apply any antibiotic to the soil in order to control *Poria,* but we have started to study the behaviour of *Poria* and *Trichoderma* when we bring them together on an artificial food base and in soil.

When we had got as far as that, an estate nearby was so alarmed by the costs of *Poria* eradication that it was looking for a cheaper method than sifting the soil. They asked for our opinion when they started to disinfect soil by D-D fumigation against *Poria* and it was then that a very happy co-operation developed on this subject. Both approaches finally came together in one working hypothesis based on the antibiotic action of this saprophytic fungus, *Trichoderma viride.* It had been proved earlier that *Trichoderma* can parasitise and antagonise a number of parasitic soil fungi among which are *Rhizoctonia solani, Armillaria mellea* and *Fomes lignosus.* It has also been shown that parasitic soil fungi are much more sensitive to D-D fumigation than is *Trichoderma.* What is left of living mycelium of a parasitic soil fungus, after this partial soil sterilisation, can then be finished off by both antagonistic and parasitic action of *Trichoderma* (*see* Plate 1).

So far we have been able to show that antagonistic action of *Trichoderma* on *Poria* does indeed exist. We have *not* observed any *parasitic* action but this might depend on the strain of fungus we have used.

Naturally we cannot yet say whether D-D fumigation or any other partial soil sterilisation will have a future as a *Poria* eradication measure because the experiments have not lasted long enough. *Poria* might survive the treatment in deeper soil layers or under the bark of bigger roots. Successive planting of the experimental area with *Tephrosia* and tea will show us whether the treatment is reliable. For the moment our results are a nice illustration of the hidden capacity of the soil itself to deal with parasitic fungi. This capacity can come out in the open if we help the micro-flora to develop in a favourable direction by drastically changing its composition by partial sterilisation of the soil. The role of organic matter in this process is of the highest importance as it serves as a food base for the harmless and even beneficial saprophytic soil fungi.

I would like to end my talk by citing one of the foremost specialists on the subject of antibiotics, Dr P. W. Brian, who summarised the problem in 1956 as follows:—"The idea I want to leave in your minds is this: that root disease is not just a private affair of host plant and parasite, but that the rich saprophytic microflora of soil and plant surface is also intimately involved."

Question.—Superintendent, Meddecombra North.

Does Dr Mulder recommend the digging of an isolation trench or drain round a treated patch of *Poria*? Or is it considered that a ring of *Tephrosia vogelii* is preferable?

Dr Mulder: The trench has been omitted from the recommendations because it has been shown that a trench of two feet is not an absolute barrier to *Poria* (Reference: Gadd, C. H., *Monogr. Tea Prod. Ceylon* no. 2, p. 38). The area is forked and cleared of roots to a depth of three feet and all roots you find going to lower depths are followed up and cleared out. Only if you want to leave the area for some time after pulling out the bushes, then it might be good, to fill up the time lag between the pulling-out of the bushes and forking, to isolate the whole area with a trench of three feet depth; although the value of it is doubtful.

As to the value of an indicator plant, if you are not fully convinced that your *Poria* gang has done a very thorough job, then it is certainly a good thing to plant *Tephrosia* at least along the border between healthy tea and the patch, because it will show what kind of job has been done, and it is better to know that before you plant the new tea.

Question.—Mr K. D. Seelanatha, Matale West Estate.

It has been found that generally the micro-life in the rhizosphere is beneficial and even essential to the plant, like saprophytic fungi, mycorhiza, nitrifying bacteria, predators etc. Isn't soil sterilisation bound to eliminate this useful micro-life, resulting ultimately in lowering the uptake of nutrients and consequent loss of yield?

Dr Mulder: The questioner is indeed right in assuming that many features of micro-life in the soil are beneficial to the plant. Total and enduring sterilisation of the soil would therefore be harmful to the roots; this is, however, difficult to achieve, and what we are envisaging is only partial sterilisation. Moreover, some time after this procedure, infection from all sides and by all kinds of organisms will occur, repairing the damage done to the microflora.

Question.—Mr C. B. Perera, Mahacoodagalla, Halgranoya.

I presume the digging of a trench is not favoured because roots from outside the isolated patch find their way into the patch below the level of the drain? Is it not possible to eliminate this by filling the trench and periodically cleaning it out, cutting off any roots that grow into the trench and filling the trench again with clean soil?

Dr Mulder: Trenching is not favoured for two reasons: (1) *Poria* rhizomorphs could possibly grow from the patch below the bottom of the trench to healthy tea outside; (2) roots of healthy tea could indeed grow below the trench, into the patch, and pick up *Poria.* Moreover a strong argument against trenching is that a trench decides on where the border of the *Poria* patch is. Anything happening outside the trench is no longer under control. If in this process of trenching a recently infected bush remains outside the trench then such a bush provides a further source of infection without being checked. If the trench is dug after uprooting two rows of healthy bushes then the whole procedure is not necessary at all, provided removal of all roots above pencil thickness to a depth of three feet is done immediately after clearing the patch. If, however, there is a time-lag between the latter process and the forking to three feet depth then a deep trench of three feet might be at least of some use. Digging a trench and filling it up again does not seem to be an economic proposition.

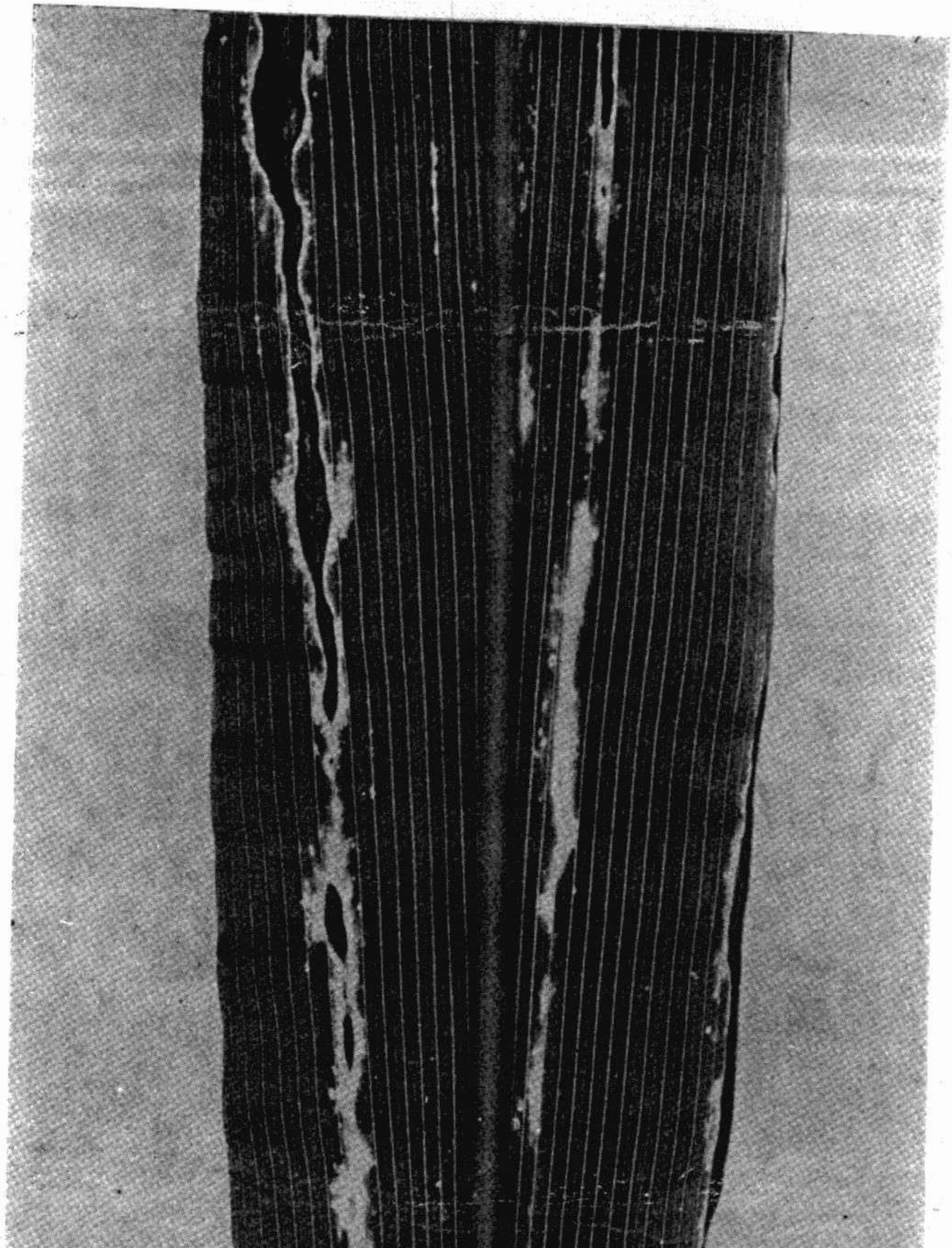

Plate 1. Bacterial leaf stripe disease of Guatemala grass (*Tripsacum laxum* Nash). **Photograph** taken with background light in order to increase contrast between green leaf, yellow diseased area and grey-black, necrotic area.