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SOFT ROOT ROT — A NEW ROOT DISEASE OF TEA?

P. V. Arulpragasam and S. Addaickan

(Tea Research Institute of Sri Lanka, Talawakele, Sri Lanka)

During the last few years a number of estates reported the death of plants in the fields that were recovering from pruning. In most of these cases tipping has been done into the dry weather, which has been severe and rather prolonged. Examination of these plants showed the total absence of feeder roots and the death of the larger roots at the distal ends, which had a kind of soft rot. Further investigations revealed the presence of large nematode lesions on the larger roots and the presence of weak parasitic fungi on the old lesions. It appears that the death of these plants have been brought about by a combination of factors, the primary predisposing factor being *Pratylenchus loosi*, the nematode causing root-lesions on tea.

INTRODUCTION

During the past few years a number of estates in the Dimbulla, Agrapatna and Pundaluoya districts have been alarmed by the increasing number of dead plants in the fields that were recovering from pruning. All these reports were of old seedling tea fields which either recovered poorly after pruning or after a moderate recovery died suddenly, especially during a long dry spell. Almost all these plants had severe wood rot of the collar and frames; and in the past their deaths were attributed to general debility brought about by severe wood rot.

Recently, a few estates reported the death of a large number of plants in their pruned clonal fields. These plants have apparently recovered well after pruning, but after tipping they were dormant for a time before they showed symptoms, similar to that of seedling tea, before they died. It was observed that plants of clone TRI 2025 were not affected. In these cases also death occurred during the dry spell. These clonal plants did not have any wood rot as in the case of seedling tea, but die-back of the large roots was observed. These plants, which were 20-25 years old, were easily pulled out by hand, becuase most of their larger roots were dead. In view of the similarity of the symptoms, the diseased seedling tea bushes were re-examined and it was found that they too had a similar type of soft rot of the large roots, starting from the distal ends or end-forks of the roots.

Many estates still consider this condition, found in old seedling tea, as being brought about by the fungus *Poria hypolateritia*, although no symptoms of this disease are found in these diseased bushes.

The present study was undertaken to determine the cause of these deaths, as there has been an increase in the number of plants affected in recent years.

METHODS

Two affected areas, one of clonal tea (at Mattakelle Estate) and the other of seedling tea (at Diyagama West Estate), each about one acre in extent were used as observation plots for the last two and a half years for this study.

Observation of symptoms

The sequence of visible symptoms of this disease is as follows: The affected bushes become dormant and the foliage turns dull green, loosing its lustre and waxy sheen. The leaves gradually turn yellow and at this stage may get sun-scorched. Then the leaves begin to wilt and dry, but remain attached to the stem. The bright brown colour of the dried leaves is striking in its appearance. Infected plants can easily be pulled out by hand even at the very early stages, because by this time the distal ends of most of the larger roots, which anchor the plants, are dead. It takes about 3-6 months for a plant to die, from the time the symptoms are first noticed. Prolonged dry weather was found to accelerate the death of these plants.

If it rains during the early stages, before the leaves begin to wilt, then the plant recovers, but remains mostly dormant and the mature leaves do not regain their lost lustre and waxy sheen, even though they might put out new shoots and resume growth. Most of the plants which just managed to survive the dry spell in one year were found to succumb during the dry season of the following year.

When some of the affected bushes were dug up, it was found that the distal ends of the larger roots were dead, the wood being soft and pulpy. In most cases the bark of the dying roots were found to be covered by thick strands of white mycelium, showing pronounced branching. When the bark is peeled off a sheath of white mycelium can be seen on the wood and on the inner surface of the bark. The root-rot has always been observed away from the collar region- at the distal ends or end-forks of the roots. The focus of entry of the fungus or fungi causing the soft-rot, therefore, appears to be at the distal ends of the roots.

This disease has been observed on single bushes as well as on bushes in large and small patches. The slow spread of the disease to adjoining bushes was observed in our plots.

Conditions favouring the disease

The appearance of symptoms, the severity of the attack and the subsequent casualties seem to be directly related to the time of pruning and tipping and dry weather conditions. It was clear from the observations made that the disease is severe and is fatal during prolonged periods of dry weather, such as those experienced during the last three years.

Comparison with other root diseases of tea

This root disease did not seem to be similar to any of the recorded root diseases of tea. Unlike other known root diseases of tea, the symptoms are prolonged over a period of time, depending on weather conditions. In this case, death has been observed to occur during prolonged dry weather conditions, whereas, in the known root diseases of tea, wilting of the leaves and subsequent death of the infected plants can occur even under extreme wet weather conditions. In this case, wet weather appears to prolong the life of the affected plant, at least until the next spell of dry weather.

The closest resemblance this disease has to any root disease is to that caused by *Fomes lucidus* (*Ganoderma lucidum*), which is considered to be a secondary root disease in N.E. India, attacking debilitated plants (Petch, 1923; Sarmah, 1960).

Study of feeder roots

It was observed that the affected plants had little or no feeder roots, whereas, adjoining apparently healthy plants had normal amount of feeder roots. Affected plants were periodically examined for the presence or absence of feeder roots over a period of two and a half years and it was significant that the affected plants were devoid of feeder roots even under prolonged wet weather conditions.

Pathogenicity studies with fungi isolated from affected roots

Three fungi, that have been constantly isolated from diseased roots and from soil around these plants, have been identified with the help of the Commonwealth Mycological Institute. Pure cultures of these were grown on sterile root segments and inoculated to plants grown in pots. These plants were allowed to grow for three months and then given a cut-across and subjected to moisture stress by with-holding water as long as possible, in attempts to simulate field conditions. None of the fungi had any effect on the plants even one year after inoculation. We were unable to recover the fungi either from the root segments or from the inoculated plants.

Effect of foliar sprays of Gibberellic Acid and the systemic fungicide Aliette on affected bushes

Two experiments were carried out in October 1981, to find out whether the affected bushes, which were dormant, could be made to grow vigorously by the foliar application of Gibberellic acid, a growth hormone, and Aliette (Fosetyl-Al 80%), a systemic fungicide, so that the plants would be able to overcome the disease. One experiment was carried out at Mattakelle Estate on clonal tea and the other on seedling tea at Diyagama West Estate. The experiments were of the randomized block design, with six replicates for each treatment. Each plot had 50 bushes and the spraying was done once a month, for a period of eight months, starting in October 1981. The treatments applied were 1. Untreated control 2. Gibberellic acid - 20 ppm 3. Aliette 0.25% 4. Gibberellic acid - 20 ppm + Aliette 0.25%. At the end of this period it was observed that there was no improvement on the growth and vigour of the plants and also that deaths of affected plants occurred during March-April 1982, in spite of the treatments.

Nematode studies

The occurrence of the diseased bushes in patches and the slow but steady spread of the disease indicated the possibility of nematodes being associated with this disease. Surprisingly, the nematode count in the affected areas was low, whereas, the count in the adjoining apparently healthy bushes, with feeder roots, was high. The nematode count in plants of TRI 2025 was low and they were apparently not affected by the disease.

Sivapalan (1982) pointed out that in the absence of feeder roots, the nematodes would move on to the larger roots and in such cases it would be unlikely that a high count would be obtained from the soil around affected bushes. Following this advice we examined the larger roots and found large number of lesions caused by the root-lesion nematode *Pratylenchus loosi* Loof. These nematodes were also extracted from the lesions in large numbers. Many of the older lesions have been found to have turned black and were infected by various fungi.

DISCUSSION

From the investigations carried out and the observations made during the past 2½ years, it appears that this condition, referred to as soft-rot, resulting in the death of the plant, has been brought about by a combination of factors, the primary predisposing factor being *Pratylenchus loosi*, the nematode causing root lesions on tea. The idea of the nematode being the primary predisposing factor is supported by this fact that plants of clone TRI 2025, planted in the same area, were found to be apparently unaffected by the disease and the nematode count in these plants was also found to be low. Clone TRI 2025 is regarded as being moderately tolerant to root-lesion nematode.

The sequence of events leading to the disease and ultimate death of the plants could be considered in the following manner. Nematode infected plants have less feeder roots than normal plants and at the same time larger roots are also attacked by the nematodes. Thus at the time when the bushes are pruned, they are in a weak condition. Pruning further reduces the amount of feeder roots. When the plants recover from pruning, the reserves in the roots are reduced to a great extent. Some feeder roots will develop during the recovery from pruning, but this will be again reduced by the nematodes and by prolonged dry weather. These plants receive further set back when they are tipped into the dry weather. Root reserves will be further depleted and in the absence of feeder roots the nematodes will feed on the larger roots, forming lesions, and making the roots weaker and susceptible to attack by weak parasitic fungi. The old nematode lesions will serve as a points of entry for the fungi. Thus there appears to be an interaction between nematodes, weather, pruning, tipping and fungi. Even if the weather changes and the plants manage to survive, the nematodes and the fungi which have gained a foothold in the plant will decidedly be at an advantage in the weakened plant. And when the next dry spell comes along the plant will have no chances of survival.

The only method of control of this condition is to replant these areas after rehabilitation with nematode tolerant clones, following the procedures laid out in TRI Advisory Circular No. N 4 (Serial No. 5/76).

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Fig. 1 — Vacancies in a clonal tea field caused by soft root rot.

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Fig. 2 — Sequence of symptoms of the disease. Branches taken from affected plant.

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Fig. 3 — Affected clonal plant which just survives the dry spell in the first year. Note poor growth.

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Fig 4. — Affected plant with the leaves dried up, just before defoliation.

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Fig. 5 — Root system of affected clonal plant. The distal ends of the larger roots are dead and pulpy. Note absence of feeder roots.