

RING-BARKING OF YOUNG TEA PLANTS IN NEW CLEARINGS

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In new clearings many plants are lost during the first two years due to the ring-barking of these plants at the collar region. It was found that besides *Phomopsis* there were other causative agents like *Rosellinia*, White grubs, Mealy-bugs and wind that could cause ring-barking of young plants. In view of the similarity of the symptoms, it is necessary to ascertain the cause of death so that appropriate control measures could be adopted. This paper gives a description of the various causative agents which were found to be associated with the ring-barking of young plants and their identification in the field with a brief outline of the methods of control. From these studies it appears that *Rosellinia*, the fungus which is normally associated with the Black Root Disease of tea, causes more deaths in young tea plants by ring-barking than hitherto believed.

INTRODUCTION

The death of young tea plants in new clearings poses a serious problem in the replanting programmes of many estates. We have had reports, from several estates, of the death of young plants in their new clearings, mostly in the first and second year fields. In 1982, for instance, one estate in the Bogawantalawa District lost 1200 plants in a two hectare block, planted in July 1981. Resupplying the vacancies, caused by these deaths, adds to the already prohibitive cost of replanting.

In some instances it was found that deaths were directly due to the effect of prolonged dry weather conditions. But in most cases it was found that plants died during the wet weather as a result of being ring-barked at the collar region, as was the case of the plants that died on the estate in Bogawantalawa district. The ring-barking in some cases appeared to be different from the others, appearing to be caused by different factors, even though the net result was the same.

Ring-barking is produced by the gradual killing of the bark at or around the site of infection or damage. The infected or damaged area may be regular or irregular in shape, often sunken and grey to black in colour. On scraping with a knife, the underlying dead tissues can easily be seen. In cases where the collar region is girdled completely, a thick ridge of callus tissue may be formed at the upper margin of the infected or damaged area.

This study was undertaken to investigate the various types of ring-barking, so that a correct identification of the causative agent could be made. This would enable estates to adopt the appropriate control measures to prevent the death of young plants in their new clearings.

INVESTIGATIONS

Time of occurrence and symptoms

During these investigations it was observed that except for the plants that were directly affected by the drought most of the casualties occurred during the

rainy season. The leaves of the affected plants first turn yellow and remain so till such time as the collar region is completely ring-barked. Then the leaves dry up and remain attached to the stem before falling off. In the meantime the twigs begin to die back and then the branches and main stem dry up completely. The root system would have started to die at the time the leaves begin to yellow.

Causative agents

We were able to identify the following causative agents, which were found to be associated with the deaths of these young plants, by ring-barking, in the new clearings.

1. *Phomopsis theae* Petch

This fungus causes collar and branch canker in young tea at higher elevations (over 4000 ft). This disease is fairly widespread in the planting districts of Badulla, Bandarawela, Haputale, Madulsima, Udapussellawa, Nuwara Eliya and in the drier parts of Dimbula, Agrapatna, Bogawantalawa, Hatton and Dickoya.

The disease is primarily seen in young plantations, causing the death of young plants 2-8 years old, by ring-barking. In older plantations it can cause branch canker and die back of young shoots (Shanmuganathan, 1965).

This disease is associated with dry weather and poor soil conditions. It was particularly bad during the last few years, specially because of the long dry spells that we had. It is known that infection takes place during the dry season, but the symptoms were noticed only with the onset of the monsoon.

Examination of the affected plants showed cankers on the stem, at the collar region. In the early stages they were not so apparent, but older cankers were easy to recognize by their raised margins, due to the development of callus. If the fungus killed a complete ring of the bark on the main stem, the plant died within a couple of months (Fig. 1).

The identity of the causative fungus was confirmed by culturing a piece of bark from the leading edge of the canker. The dead bark tissue when kept under moist conditions produce the characteristic spores which can be easily identified (Shanmuganathan, 1965).

2. *Macrophoma theicola* Petch

This fungus causes stem canker in tea grown at low elevations and in some mid-country estates (Petch, 1923). In old tea it causes branch canker or kills young shoots and in severe attacks may kill the entire bush by girdling the main stem. In recent years there has been an increase in the incidence of this disease and it has been observed to kill young plants in new clearings by ring-barking of the main stem (Fig. 2). Clone TRI 2023 was found to be very susceptible to this disease.

Severe attacks of *Macrophoma* were observed immediately after the prolonged droughts. The predisposing factors favouring the incidence of this disease are similar to those of *Phomopsis*.

In young plants, in the new clearings, the disease first appears as slightly sunken dark patches on the main stem and on the red wood of branches. In some cases, the growth of the fungus is arrested by the formation of a callus, during

favourable weather conditions. In many cases, in young plants the bark is killed around the collar region, encircling it completely, eventually killing the plant.

The causative fungus was identified, as in the case of *Phomopsis* by culturing the bark from the leading edge of the canker and by the spores that were produced by the fruiting bodies or pycnidia which were found on the dead bark tissue (Petch, 1923).

3. *Rosellinia arcuata* Petch

This fungus is better known for its ability to cause the common root disease called Black Root Disease in mature tea than for its ability to cause the ring-barking of young plants. This disease occurs mainly in areas over 2000 ft in elevation and more frequently in the drier areas of the up-country districts.

It is able to grow easily on leaf litter on the surface of the soil during damp weather conditions. It spreads rapidly growing along the layer of dead leaves and when it reaches a tea bush it first encircles the collar of the bush and then grows downwards and attacks the roots. The fungus was observed to attack and kill a large number of plants simultaneously.

In new clearings, the fungus was observed to cause severe damage at the collar region, where the tissues were killed resulting in the ring-barking of the plants (Fig 1). In our recent observations, we came across several instances where the death of these plants was attributed to *Phomopsis*, since deaths due to this fungus also occurred at the onset of the monsoon, soon after a period of dry weather.

In the new clearings, where this disease occurred, we found that these areas were heavily thatched and had dense shade. These precautions were taken to protect the young plants during the dry weather, which unfortunately, seemed to be their undoing during very damp weather conditions.

White to black strands of mycelium can be found on dying plants, on the bark at the collar region and on and within the leaf litter or thatch surrounding the affected plants. The fungus produces two kinds of spores, conidia and ascospores. The conidia are produced in large numbers on short bristle like stalks on the affected area and present a black velvety appearance. Ascospores are produced on plants which have been dead for a long time, among the bristle like stalks which bore the conidia.

Tephrosia vogelii, if present in these affected areas, was also attacked by this fungus and found to be ring-barked as in the case of the tea plants (Fig. 3). The bristle-like stalks, bearing the conidia, were more easily seen on the *Tephrosia* plants than on tea.

4. Mealy-Bugs

The mealy-bugs (family Pseudococcidae) are coccoids related to the scale insects. These are very occasional pests of tea, more commonly recorded on rooted cuttings and young plants in nursery beds (Cranham, 1966).

Dense infestation of mealy-bugs was observed in the new clearings of a few estates. In all these cases it was observed that the plants were heavily thatched, right up to the collar region and in addition had the planting-basket around the collar, thus creating very humid and damp conditions around this region.

On dying bushes the mealy-bugs can be easily seen, just below the callus, covered with a mealy or white filamentous waxy secretion (Fig 4).

5. *White Grubs*

White grubs, as they are commonly known, are larvae of various Scarabaeid beetles (chafers or cockchafers). Of the many species which occur in tea fields, it has been found that damage to roots of young tea was caused largely by one species, *Holotrichia disparilis* Arrow. This species occurs in up-country districts above about 3000 ft and is more commonly noted above 4000 ft, particularly in Kandapola, Maturata, Hewaheta, Udapussellawa and Dimbula (Cranham, 1966).

Damage can occur in first or second year new clearings, usually from August to December. But the effects of the root damage can be observed only during dry weather spells from January to March. This gives the impression that the damage is being done during this period, when in fact the grubs would have pupated and ceased to feed by that time.

White grubs have been found to chew the roots off completely, leaving a callused stump. They have been found to feed on the bark at soil level, resulting in the ring-barking of the stem (Figures 5 and 6).

6. *Deep Planting*

Deep planting and or soil getting heaped around the collar. Plants that have been planted deep have been observed to develop 'collar-rot' in many instances. This may be purely due to mechanical damage or due to invasion of the damaged bark by fungi. Sometimes, white grubs have been found to feed on the dead bark of deep-planted plants, bringing about a secondary effect of ring-barking.

7. *Wind*

In wind swept areas, the young plants are swayed to and fro resulting in damage to the bark at soil level. There is usually a cavity, around the plant, which is quite compact and does not allow water to flow down, resulting in 'mini' water logging. Roots of such plants were found to be black and as the plants die, were found to decay.

In wind damaged plants it was found that there was no callus and the bark of affected plants was sunken but intact (Fig. 6). The vast majority of plants damaged by wind was found to be clone TRI 2025, which appeared to be very susceptible during the first two years.

Identification of the causal agents

The time of occurrence of symptoms or the death of the plants and the position of the canker in relation to the soil level were found to be useful guidelines in determining the cause of death of young plants in new clearings.

We have already seen that the plants attacked by white grubs show evidence of damage mostly during the dry weather spells from January to March. In most cases the grub will not be found around the root zone when the dead plant is dug up. There are other symptoms, as will be mentioned later, by which white grub damaged plants could be easily identified. In most of the other instances where young plants are ring-barked, the symptoms and death are noticed mostly during wet weather

conditions. In some instances, an intervening period of dry weather has been observed to accelerate the death of these affected plants.

I. Ring-barking above ground level

(1) *Phomopsis* (up-country stem canker). In plants affected by *Phomopsis* the lower margin of the canker is above ground level or at ground level. The callus is usually thick, with a smooth surface. Progress of the disease is comparatively slow. Confined to the up-country.

(2) *Macrophoma* (low-country stem canker). Similar to the up-country stem canker. In this case the surface of the callus is uneven and in most instances the canker has also been found to run longitudinally up the stem. Confined to the low-country and to the mid-country.

(3) *Rosellinia*. In most cases, the lower margin of canker, has been found to be at soil level or at the level of leaf litter or thatch. The callus is thick with uneven surface. Progress of the disease is quick.

(4) *Mealy-bugs*. Canker, small and close to the soil. Mealy-bugs and their white secretions are usually found at the collar and on the canker.

II. Ring-barking below ground level

(1) *White grubs*. Callus may be small or absent. Bark below ground level eaten clean by the grub, leaving only the wood. Absence of smaller roots and feeder roots.

(2) *Deep planting*. Slight callus. Collar rot may have set in by the time affected plants are discovered. The dead bark below ground level may be intact or cleaned up by white grubs. But unlike in plants attacked by white grubs, here the root system will be intact.

(3) *Wind damage*. No callus has been observed in wind damaged plants. The bark at the collar region has been found to be dead but intact and sunken. A cavity has usually been observed in the soil around the stem. If water logged, the roots are found to be black and decayed with a characteristic smell.

CONTROL MEASURES

A brief description, of the methods of control, which are already known, is given for the sake of completeness of the present study.

Phomopsis and Macrophoma: The prolonged periods of dry weather that we have had during the past few years has brought to light that under extreme conditions of moisture stress no clone is truly resistant to these two diseases. Therefore, to prevent a serious incidence of these diseases, it is important that planting of recommended "Resistant" clones (Shanmuganathan, 1969) should go hand in hand with modified cultural practices (Shanmuganathan and Bopearatchy, 1972). The timely establishment of a good cover of shade, and thatching during the dry periods are two of the basic requirements to keep these diseases under control.

Rosellinia: Heavy shade should be thinned out and the thatch should be moved away from the base of the plants during the rainy season. Infected plants and the leaf litter and or thatch around them should be collected and burnt on the spot.



Fig. 1 – Young tea plants ring-barked by Phomopsis (right) and Rosellinia (left).



Fig. 2 — Young tea plant ring-barked by Macrophoma.



Fig. 3 — Tephrosia plants ring-barked at the collar by Rosellinia.



Fig. 4 — Young tea plant ring-barked by mealy bugs. Note white secretions at the collar region.



Fig. 5 — Young tea plants ring-barked by white grubs. Note absence of smaller roots and feeder roots. Bark eaten clean by the grubs.



Fig. 6 — Ring-barking of young tea plants by white grubs (right) and by wind (left). Note the absence of feeder roots in the former and the presence of all the roots and the intact bark at the collar in the latter.

Cleaning of the infected area should be done as for the control of root diseases. Affected area should not be replanted at least for a period of six months.

Mealy-bugs: Heavy shade should be thinned out and thatch moved away from the base of the plants during wet weather conditions. Drainage should be improved. Spread could be controlled by the application of insecticides like Malathion and Lannate.

White grubs: Reduce the application of organic matter in known pockets, especially the application of tea-fluff. Thatch should be thinned out during wet weather. Chemical control is by the application of B.H.C., Aldrin, etc.

Wind damage: In wind swept areas, wind belts should be first established before the plants are put out in the field. Avoid planting susceptible clones, like TRI 2025, in these areas unless they are well protected against the wind.

DISCUSSION

Many plants are lost annually in young clearings, especially during the first two years, due to the ring-barking of these plants at the collar region. In the past, these deaths have been mainly attributed to the fungus *Phomopsis theae*, which is known to cause collar and branch canker in young tea. The role of *Rosellinia arcuata*, the fungus which causes Black Root Disease of tea and the larvae of the Scarabaeid beetles, commonly known as 'White Grubs', in the ring-barking of young tea plants have been underestimated.

Due to the similarity of the symptoms, correct identification of the cause of these deaths is important from the point of view of the control measures to be adopted to prevent the spread of the diseases, because the control measures are different in each case.

It was found that deaths due to *Phomopsis* occur with the onset of the monsoon although infection takes place during the dry season. This has often been confused with the ring-barking caused by *Rosellinia*, which also occur during the early part of the monsoon. But in this case it was found that infection takes place during wet weather. By microscopic examination of the fruiting bodies and spores found on the dead region it was possible to identify the causative organism. Attack by white grubs was found to be seasonal, irrespective of weather, occurring during August to December, resulting in the death of the plants during January to March. The callus, in the case of white grub attack was found at soil level with the bark below being completely eaten by the grub and no spores were found on the dead region. Heavy thatching during dry weather, was found to reduce the incidence of *Phomopsis*. However, if this thatch is not thinned out or removed during wet weather, then the incidence of *Rosellinia* and white grubs was found to be enhanced. This may probably be the reason for the dilemma of Shanmuganathan and Boppearatchy (1972), who observed that the incidence of cankers is greater in young tea that is heavily shaded and that mulching with Mana grass did not show any beneficial effects with regard to disease incidence, whereas mulching with polythene reduced disease incidence very markedly. Due to the similarity of the cankers caused by *Phomopsis* and *Rosellinia*, it is possible that they assumed that *Phomopsis* was the cause of the cankers in the heavily mulched and shaded areas. Mulching with polythene reduced the incidence of cankers because *Rosellinia* possibly could not spread along the polythene mulch. The results of the present study may help to clear this misunderstanding.

The investigations and the observations made in this study demonstrate clearly that there are several factors which cause ring-barking of young plants in new clearings and that *Rosellinia* causes more deaths in young plants than hitherto believed.

ACKNOWLEDGEMENTS

Our thanks are due to the Superintendents of Estates, who drew our attention to this problem and showed us around the affected areas on their Estates.

REFERENCES

- CRANHAM, J. E. (1966). Monographs on tea production in Ceylon No. 6, Insect and mite pests of tea in Ceylon and their control. Tea Research Institute of Ceylon, p. 121.
- PETCH, T. (1923). The diseases of the tea bushes. MacMillan & Co., Ltd., London, p. 220.
- SHANMUGANATHAN, N. (1965). Collar and Branch Canker in young tea caused by *Phomopsis theae* Petch. *Tea Q.* 36, 14-21.
- SHANMUGANATHAN, N. (1969). Studies on collar and Branch Canker Disease of young tea (*Phomopsis theae* Petch). III - Clonal resistance. *Tea Q.* 40, 164-174.
- SHANMUGANATHAN, N. and BOPEARATCHY, R. N. (1972). Studies on Collar and Branch Canker disease of young tea (*Phomopsis theae* Petch). 4 - Effects of some cultural treatments on disease incidence and severity. *Tea Q.* 43, 36-44.