

SOME FACTORS ASSOCIATED WITH THE DEATH OF TEA PLANTS IN LOW-LYING LANDS

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With the rapid expansion of the tea small holding sector in the low country, there is a significant increase in the use of flat lands for tea cultivation (Fig.1). A high incidence of retarded growth and death of young as well as mature tea plants in flat or low-lying lands have been recorded from time to time, but more common in the recent years. Inadequate soil aeration due to poor drainage causes poor root penetration into deeper layers, which is a characteristic of the tea plant in such lands. Hence, the shallow root system makes the tea bush more vulnerable to drought damages. Therefore, number of casualties both in young and mature tea lands are high under these conditions. This paper attempts to discuss some of the attributes of such casualties and remedial measures in order to overcome them.



Figure 1. Tea field more prone for water logging condition

General soil conditions of the low-lying lands

The soils of these lands are of heavy alluvial type which are clayey and of a very fine structure. They may contain well-compacted layers of clay interspersed with gravel. Hence, it has a high water holding capacity. The layer of topsoil is likely to be very shallow and even the lateral movement of water is too slow

for satisfactory drainage. Formation of a hard pan as a result of compaction of soil layers, in such lands might serve as a barrier for root penetration. Such poorly grown shallow root systems can lead to more casualties in tea during drought. Therefore, this kind of soils is unfavourable for growth of the tea bush both under wet as well as dry weather conditions.

Root growth of the tea plant

The depth, spread and density of root system may influence the success of survival to a greater extent during drought. The soil factors that influence root growth are soil texture and structure, which in turn govern other physical properties such as water holding capacity, soil aeration etc. and chemical properties like soil pH, available minerals and toxic substances (Kramer,1983). The root system of the tea bush can be divided into two parts; 1. Main or primary roots 2. Feeder roots.

The functions of main roots are to anchor the plant in soil, act as reservoir for surplus carbohydrates and to act as the main arteries through which nutrient and water will pass on to the aboveground parts. Therefore, a well-developed deep root system is essential for the uninterrupted growth of the bush. It has also been recorded that the effective root depth of 12 year-old tea at Borbhetta in India was 76 cm and maximum root depth was 101 cm (Dutta,1968^a). Maximum root depth of 7 year-old VP tea plant in the low country in Sri Lanka was 75 cm while the effective root depth was 45 cm under similar condition (Wijeratne,1994). Although the main root may absorb some water and perhaps some nutrients, the quantities are very small and are highly inadequate for normal growth.

Feeder roots are very thin whitish to brownish, and concentrated mainly in the topsoil. They absorb soil moisture and nutrients. Some feeder roots can be found in the lower layers of soil. However, Eden (1943) has observed in Sri Lanka that there are practically no feeder roots below 61 cm, where water table is very high during the monsoon period. Barua and Dutta (1961) also recorded that the feeder roots did not penetrate beyond 70 cm depth at Borbhetta in India under such situations. When the topsoil dries out, there is an obvious setback to the growth of feeder roots, which will reduce the uptake of water and nutrients. This in turn will have adverse effects on the growth of the tea bush.

Causes of poor soil aeration

A soil is said to be of good "tilth" when its physical condition allows free movement of air through it. A soil with a good tilth breaks up easily into crumbs or granules, while the soils of poor tilth will be cloddy (Dutta, 1968b). As a result of the poor structure and high water table, soils in low-lying lands are

not adequately aerated. This will affect normal development of roots of the tea plant in low-lying areas. Under such conditions tea roots do not penetrate to deeper layers.

The water table is considered to be an important factor in determining the depth of any root system. A shallow, free water table is a condition, which prevents the penetration of tea roots into deeper layers of soil. Water table tends to rise during monsoons, and hence, water is freely available on the surface layers.

The impervious layers found below the topsoil surface are referred as hardpans and they do not allow deep percolation of water. Under these circumstances, a layer of water is often retained above this hardpan. This is known as a perched water table. During wet weather, water does not drain away because of the hard pan and heavy clay content. This may result in the rise of the water table thus displacing the air from such soil. As a result, plant will suffer under a temporary anaerobic condition. This condition also adversely affects the growth of feeder roots, which require a plenty of air, for better growth. This leads to die back and decomposition of feeder roots. Only those feeder roots near the soil surface remain alive. During dry conditions, root cannot grow through these impervious layers, as soil will cake-up and crack faster, depriving the plants of sufficient moisture.

The fluctuation of water table in low-lying lands therefore, leads to the development of a weak root system. Consequently plants become weaker. Such weak plants are easily susceptible to canker, caused by *Macrophoma theicola* and more vulnerable to drought. Therefore, in such situations, if tea has to thrive, it is most essential to ensure that there are no hardpans, causing a perched water table or a naturally high ground water table.

Typical symptoms of the tea plant affected by poor aeration

The foliage of the affected tea bushes are sparse as a result of defoliation and the failure of producing new leaves. Leaves tend to show slight chlorosis. Moreover, affected bushes show prolonged shoot dormancy (bangi formation) and stunted growth. Flowering and fruiting can be profuse (De Silva, 1967). In advanced cases, complete defoliation takes place. The recovery after pruning is very poor (Fig. 2).

The root system of VP plants growing in low-lying areas are very shallow. Roots may grow towards the surface resembling an inverted umbrella (Fig. 3). The development of feeder roots is typically poor, and they will be confined to the surface layer of soil. Pronounced lenticels are a common feature in the collar region of the affected bushes, to allow gas exchange between the atmosphere and the internal tissues. Roots become swollen and brittle. In many cases, roots will die and decay.



Figure 2. Typical symptoms on foliage under waterlogged conditions.



Figure 3. Typical symptoms on root system under waterlogged conditions

Remedial measures

Firstly, the causes for the development of a weak root system should be ascertained. If the root system is shallow, the reason can be either water logging or a shallow soil. If water logging is the cause, drainage must be improved. Where there is a poor lateral spread of roots, it is likely that the physical conditions of the soil are poor. Under such conditions, efforts should be made to improve the physical conditions by addition of organic matter. Following agricultural practices can be adopted to minimize further casualties and to increase the productivity of such land.

1. Soon after noticing of above symptoms on tea bushes growing in low-lying areas, allow resting and light plucking until the affected bushes recover completely.
2. Cut adequately deep drains [about 3'-3.5' (90-105cm)] to drain-off excess water from the low-lying lands.
3. Loosen compacted soil layers by resorting to envelop forking. It is desirable to open up soil without turning over the clod so that there is a minimum disturbance to the feeder roots. This is achieved by adopting an envelop forking on every other tea inter-row, once in two pruning cycles in the low country and once in a pruning cycle in the up country. Forking should be undertaken about 3-4 months after pruning when the bush has sufficient foliage. No forking should be done during or prior to the onset of dry weather.
4. Incorporate adequate compost material into soil, immediately after envelop-forking.
5. The addition of mulch (grass loppings or shade loppings) between tea rows will improve soil fertility.
6. Give a drenching spray of a suitable fungicide to the frame of tea bushes in the affected area once in 2-3 months to avoid any pathogenic infections.
7. Maintenance of good standard of shade trees reduces casualties.
8. Pruning should be carried out cautiously. Avoid very hard pruning and do lung pruning after resting of tea bushes for a period 2-3 months.
9. All the weak and dead plants should be uprooted and vacant patches planted with Mana or Guatemala grass for a minimum period of 2 years.
10. Ensure that healthy and vigorous nursery plants are selected from recommended clones for planting.

Avoid planting of TRI 2026 in the low-lying lands as it shows poor performances when compared to other clones under such conditions. It was observed that the clones, which have characteristically shallow root systems (TRI 2023), perform

better than the clones with characteristically deeper root systems (TRI 2026) in the low-lying areas. Hence, proper selection of clones considering the soil conditions of low-lying land is of paramount importance.

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