

**THE IMPORTANCE OF LUNGS AND ROOT RESERVES
IN THE RECOVERY FROM PRUNING AT LOW ELEVATIONS**

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Introduction

Tea is a closely planted perennial crop in which the tender apical shoots are harvested. The sustainable productivity of tea lands depends on the capability of producing shoots and on the longevity of tea bushes. Therefore, prevention of death of bushes and maintenance of a healthy frame with dense branches for profuse shoot production are prerequisites for sustainable productivity. This is illustrated by the field observations, which show that casualties in a field incur greater loss of productivity and that bushes with an open and thin canopy characterized with a low shoot density also yield less (Figure 1 & 2). Bush management *viz.* management of bush height, spread and vigour is largely accomplished by pruning and plucking and as a result, these two field practices have a profound effect on the productivity. Of these two field practices, pruning is found to be the main critical factor determining frame development and death of tea bushes in the field. In many fields, a large number of casualties are recorded at each pruning and hence the causes of such casualties and remedial measures need to be properly identified.

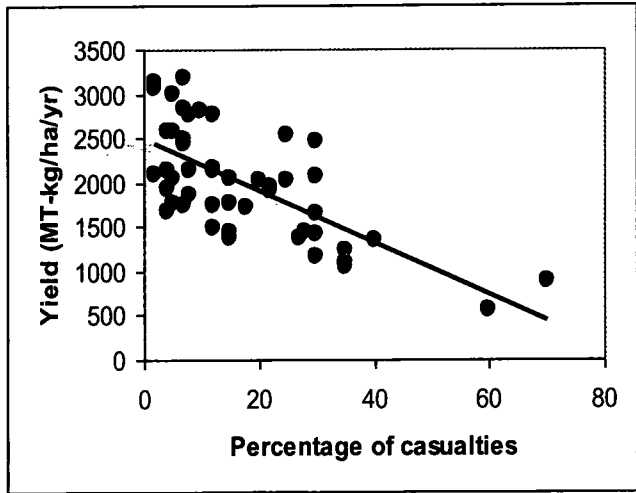


Figure 1. Relationship between yield and bush density after planting

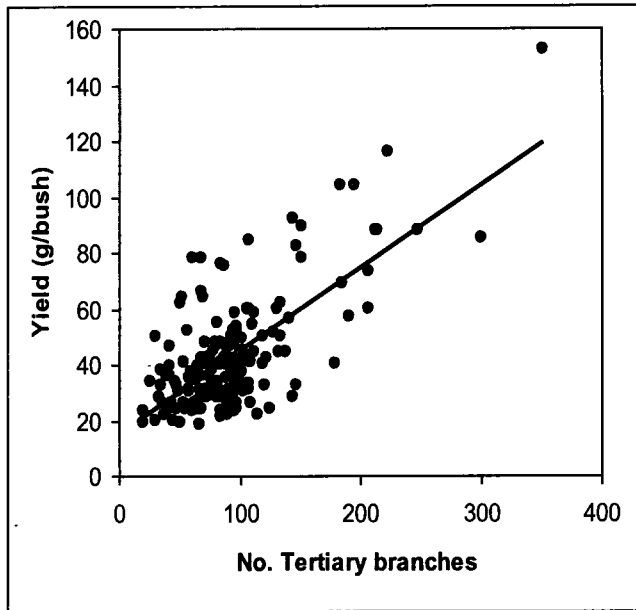


Figure 2. Relationship between yield and number of tertiary branches

Critical factors influencing recovery after pruning

Resting before pruning and starch reserves

Recovery after pruning greatly depends on the environmental conditions and level of root starch reserves. Pruning is best done with the onset of monsoonal rains before the rush crop. Recovering tea bushes should never be exposed to dry weather. The level of root reserves increases with refoliation after pruning and thereafter varies with the cropping pattern. The level of root reserves of tea bushes nearing pruning are usually high when the crop is less (during lean period) and low at the height or end of the rush crop (high cropping period). The growth of new shoots after pruning is largely influenced by the level of root reserves (Wijeratne *et al.*, 2002). Although the root reserves vary from about 10% in low grown tea to about 30% in high grown tea, the critical level with respect to recovery after pruning is reported to be about 12% (Tubbs, 1934; Krishnapillai *et al.*, 1992). Experimental evidence from low grown tea has shown that the recovery after pruning is extremely poor when the root reserves are less than 3-4% (Wijeratne *et al.*, 2002). Hence, it is extremely necessary that root reserves are fully replenished before pruning. This can be achieved by reducing sinks or users of carbohydrates assimilated by the canopy hearing pruning. Elongating buds and small shoots (*arimbus*) are considered to be the heavy users of assimilates. The dormant shoots (*banjhis*) and mature leaves on the top of the canopy are the major food producers and exporters to roots. However, the capacity to store assimilated carbohydrates depends on the size of the root system *i.e.* its root volume. Hence, presence of a well developed and a thick root system is also necessary for harnessing the full benefits of resting. Since, assimilates are also directed to roots, root reserves can be easily augmented by resting of tea bushes for 6-8 weeks. However, a resting for a shorter period of time *i.e.* for less than 6 weeks, where the growth of remnant shoots is aggressive will not be sufficient and serves no purpose.

Retention of lungs and root metabolites

Not only the root reserves but also the presence of lung branches is important for the successful recovery after pruning. The lungs have two major functions *viz* provision of photosynthates to roots to maintain the starch reserves above a critical level and to maintain the flow of metabolites from the roots to newly growing shoots. In the process, some harmful root metabolites are also moved towards the canopy. It is known that a part of feeder roots die after pruning of branches and as a result harmful root metabolites such as ‘saponins’ are formed. These root metabolites move towards the top of the canopy with transpirational loss of water. Acting as a sink for these harmful metabolites, the lungs with mature leaves dilute such toxic substances and prevents them reaching the developing buds and young shoots of pruned branches. The presence of lung branches also reduces death of feeder roots and formation of harmful root metabolites. In the absence of lung branches after pruning, the concentration of such metabolites becomes toxic and kills growing buds on pruned branches, if not scorch the edges and tip of the leaf laminar of expanding leaves where the concentration of toxic compounds are high causing rim-blight symptoms (Roberts *et al.*, 1976). This leads to poor recovery and some times death of tea bushes after pruning.

Field observations on recovery from pruning

The TRISL Low Country Regional Center, Ratnapura organized a field demonstration site for small holders. In order to demonstrate important practical aspects of pruning, a tea field (Field No. 1, St. Joachim estate) was rested for two months and pruned. Three pruning styles *viz*. ‘Cut-across’ (60 cm), ‘Rim-lung’ (50 cm) and ‘Clean pruning’ (45 cm) were demonstrated. Four rows of tea comprising 80 bushes were lung-pruned while the rows receiving other styles of pruning had 40 bushes each and were on either side of the lung-pruned block. The block was planted with the cultivar TRI 2025 and awaiting formative pruning five years after planting. Weather

conditions were conducive for pruning and post pruning practices such as lime spraying was also done.

Observations during the first two months proved that despite all good agricultural practices adopted before and after pruning and with better weather conditions, only lung-pruned bushes were able to successfully recover after the pruning without any casualties. Cut-across pruning achieved only about 7% recovery (only three bushes with few stunted shoots and rim-blight symptoms) while clean pruning gave 100% casualties. Some cleaned-pruned bushes also had few shoots with rim-blight symptoms which later died prematurely (Plates 1 & 2). As there was a marked variation in the recovery after pruning, root sampling was done to assess root starch reserves two months after pruning. The lung pruned block recorded 1.2% root reserves while that of cut-across and clean pruning was about 0.2%. Usually roots of tea bushes rested for about 2 months in the Low country record a very high level of starch reserves in the order of 9-12 (Wijeratne *et al.*, 2002). This observation helped tea growers to review their knowledge regarding the role of starch reserves and lungs. It shows that a *mere resting* before pruning is not adequate to ensure a successful recovery after pruning, but a combination of resting and lung pruning is necessary.

The very high rate of casualties observed in this field was due to the absence of a vigorous root system usually found at the time of first or formative pruning. Such bushes have few thick storage roots and the volume of the root system is also so small that adequate quantities of starch cannot be stored. Moreover, much of the reserves (about 60%) are lost by root respiration (Barbora and Barua, 1988). Under such circumstances, bushes without lungs would not have sufficient reserves to support bud break and subsequent growth of shoots. Even though, heavy casualties observed in this demonstration may not be recorded by an old tea field *i.e.* after a few pruning cycles having a fully grown root system with thick roots, a poor recovery and a high percentage of casualties

would still be found. This condition results in declined productivity of tea lands after 2nd or 3rd pruning in the low grown tea (Amarathunga and Wijeratne, 2001). Therefore, it is extremely important to raise the awareness of tea growers about the importance of adopting proper pruning policies and consequences of death of bushes after pruning, especially in the Low country where less starch reserves are found due mainly to high ambient temperatures. Once the recovery has failed due to incorrect pruning, the losses to the grower are not only the total cost of infilling, but also the loss of yield until the “infills” become productive. The approximate monetary loss by the death of a single bush after 2nd or 3rd pruning can be more than Rs. 250.00.



Plate 1. Recovery after Clean and Rim-Lung pruning



Plate 2. Rim-blight symptoms on new shoots- Clean pruning

It is therefore, imperative that tea growers adopt proper pruning policies, mainly resting for more than 6 weeks before pruning, pruning before the rush crop leaving healthy lung branches having 200-300 leaves and aiming at the most assured monsoon in the region. Further, adoption of tipping instead of plucking-in *i.e.* premature plucking at 4-5 leaf stage, helps sustain the benefits accrued by proper pruning practices.

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