Change in Growth and Productivity from Pruning and Skiffing as a Method to Prolong Pruning Cycle

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Abstract

An investigation was carried out on the impact of aging of pruning cycle on productivity parameters of two popular tea clones of TRI-2025 and DT-1 grown in higher altitudes (>900 m amsl) of Sri Lanka. Different ages in the pruning cycles considered were 1st, 2nd, 3rd, and 4th years after pruning. Shoot extension rate, thermal time requirement for shoot appearance, active and banji (shoots with retarded growth) shoots, leaf photosynthesis, leaf area distribution and black-tea yield were measured. The thermal requirement for an axillary bud to become pluckable shoot was 370 day degrees for DT-1 while it was 350 for TRI-2025. Shoot extension rate was highest at the first year of the pruning cycle for both clones. Active shoot density decreased with age, with the corresponding increase in banji shoot density. Leaf photosynthesis rate was similar and was highest for both clones during the first year and then decreasing the rates subsequently. Leaf area index increased up to 2nd year in TRI-2025 and up to 3rd year in DT-1 after pruning and reduced thereafter. Yield increased after pruning, and reached to a maximum at 2nd year for TRI-2025 and at 2nd and 3rd year for DT-1 after pruning. Thereafter, gradual decline in yield was observed for both clones. However, the productivity of TRI-2025 was greater across all years from pruning compared to DT-1. This may be attributed to the production of higher percentage of shoots per unit area, faster shoot growth, and larger shoot sizes with greater inter-nodal length compared to DT-1. Light skiffing at the 5th year after pruning enhanced the productivity by 42%.

Media Summary

Productivity decreases 2-3 years from pruning due reduced shoot activity and photosynthesis, but skiffing can prolong pruning cycle. Tea Clone TRI-2025 maintains better production than DT-1.

Key words

Tea clones, pruning cycle, green leaf production, yield potential, shoot activity

Introduction

As the world's largest tea exporter, Sri Lanka produced 295,000 Mt and earned Rs. 61,602 million (Approx. US $ 700 million) (Central Bank Annual Report 2001). Total area under tea is around 188,970 ha and the tea growing above an altitude of 900 m is known as up-county tea, consisting of nearly 40% of total tea grown area. Economic portion of tea plant is the shoot, which consists of 2-3 terminal leaves and a terminal bud. The growth of the tea shoot subsequently culminates forming the economically important pluckable shoots (Mwakha 1985). The yield of a tea bush depends on a number of active to dormant shoots at a time, the frequency and duration of flushing, the size and weights of individual shoots and surface area of the tea bush (Odhiambo 1996). The factors affecting tea shoot growth are genotype, environment and management. Management practices such as harvesting and pruning cause many branched twigs to be developed. New shoot with 2-3 expanded leaves and the terminal bud are harvested from the plucking table (top surface) every 4-21 days interval depending on various factors, after which buds in the axils of the top most leaves develop to become the next crop (Tanton 1982), Pruning is essentially the artificial removal of all or most of leaf bearing branches of the plant. It is necessary to maintain the plant at a convenient height for easy harvesting, stimulate vegetative growth, maintain healthy frame for the effective utilization of land area (Kulasegaram et al 1988). Recovery after pruning or harvesting depends on the state of health of plant, amount of reserves present and on the process of ageing, etc. When the time after pruning increases, shoots become smaller, banji shoots increase in number and more buds fail to grow, resulting in the unproductive whole branch system of the bush (Barua 1989). Therefore, after 3rd or 4th year of the pruning yield starts to gradually decline and this leads to other prunings at suitable intervals. Even though pruning stimulates vegetative growth, it results in crop losses for sometime, increases environmental hazards, and also becomes a costly process. About 5% of the total cost in the tea industry is accounted to pruning (Tea Bulletin 1999). However, the length of, and productivity during, the pruning cycle, vary greatly among tea clones, and environmental and management conditions. Physiological basis of decline in yield, clonal variations and possible ways to prolong pruning cycles have not been studied in detail. Therefore, this study was initiated to investigate the impact of aging in pruning cycle on physiological and yield parameters of two popular tea clones in an up-country tea growing region and the effects of light skiffing as a method to prolong pruning cycles.

Method

The research was carried out in an experimental field at the Tea Research Institute at Thalawakele ((lat. 6? 55' N, long. 80? 40'E, altitude 1382 m amsl, with average annual rain fall of about 2500 mm) during 2000-2001. Different years of 1st, 2nd, 3rd, and 4th of the pruning cycles of two tea clones (TRI-2025 and DT-1) with similar maturity were the treatments. Sampling plots were selected from each treatment and representative plots were identified having more than 40 bushes, and were marked.

Shoot extension was monitored weekly from randomly selected ten axillary buds on the remnant shoot stalks per tea bush (from ten bushes per treatment) which were tagged immediately after plucking until the 3rd leaf was unfurled. Thermal time requirement for the development of axillary bud to become a plukable shoot was calculated as: Thermal Time= $\sum (T_m - T_b)\, \delta t$, where Tm=mean air temp, Tb= Base Temp, δt= time interval (one day). Leaf area distribution at 5 cm interval from the top was measured from a representative bush in every plot. Leaf photosynthesis was measured from the sunlit mature mother leaf from each plot using Li-Cor. 6200 photosynthetic meter. Measurements were taken during noon under clear sky from 10 randomly selected leaves per plot. Plucking of each plot was carried out at weekly intervals, using the same plucking person. The fresh and dry weights, active and banji shoot number were recorded from a sub-sample of 100 g of leaves and dry weight of black tea was taken.

Results and discussion

Shoot extension and thermal time requirement

Thermal time requirement for shoot extension was 350 and 370 day degrees for TRI-2025 and DT-1 respectively, indicating faster shoot growth in TRI-2025. The shoot length extension was reduced by 26% in TRI-2025 and 48% in DT-1 in the forth year compared to the first year after pruning. Average shoot size was greatest during the first year after pruning and decreased gradually with aging for both clones. However, TRI-2025 was having nearly 18% larger shoots compared to DT-1.

Percentage shoots per unit area, and proportion of active and banji shoots.

Across pruning years, TRI-2025 had 8% more shoots per unit area compared to DT-1. This may be attributed to the higher number of plucking points per unit area and higher growth rate of TRI-2025. The highest number of active shoots per unit weight of green leaves was recorded in the first year of the pruning cycle for both clones and it declined progressively with the age. An opposite trend was observed for banji shoots. Active shoot number was significantly greater and banji shoot number was small in DT-1 compared to TRI-2025.

Leaf area index

LAI was highest in the 2nd year of pruning for TRI-2025, and in both 2nd and 3rd year for DT-1. Across clones, DT-1 had significantly higher LAI during whole pruning cycle compared to TRI-2025. Leaf area in the upper layers of the canopy was higher in all years, where as in the 4th year of the pruning cycle, bottom layers had lower LAI. With increasing age of pruning, canopy structure became more complex and canopy height increased. Light penetration to the bottom layers was very much limited; as a result leaves in the bottom layer were not active and started to senesce.

Leaf photosynthesis

Maximum photosynthesis for both clones was observed after the first year of pruning, and decreased thereafter with pruning age (Fig 1). The photosynthesis and the photosynthetic rate decline patterns were similar for both clones. During the first year after pruning canopy illumination was greatest. With the accumulation of more leaves with aging, proportional sunlit leaf area gradually decreased, reducing the canopy photosynthetic efficiency (Squire 1985).

Yield

Across years maximum yield was observed for TRI-2025 in the 2nd year after pruning and then reduced with pruning age (Fig 2). In DT-1, however yield was increased up to third year. For both clones yield was lowest in the first year after pruning which may be attributed to small bushes with few branches and lower LAI. Tea bushes expanded and produced more productive shoots during the 2nd and the 3rd years of pruning. Productivity tends to be reduced after the 2nd year of pruning for both clones. This may be attributed to lower leaf photosynthesis, and decreased number of active and increased number of banji shoots. Greater yield of TRI-2025 compared to DT-1 may be attributed to higher shoot percentage per unit area, lower thermal time required for shoot growth resulting in higher shoot growth rate and production of larger shoots (higher inter-nodal lengths).

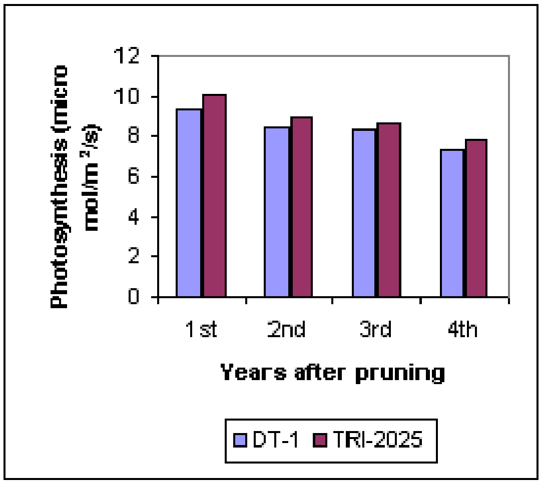
Impacts of skiffing on yield

A light skiffing (removal of the congested branches, shoots, etc. from the top canopy layer) was practiced after 4th and 5th year of pruning in order to see the possibility of prolonging the pruning cycle for enhanced yield.

Overall results revealed that the yield increment when skiffing was carried out at the 4th year was 29%, where as it was about 42% during the 5th year of pruning. Light skiffing of the maintenance foliage results in quick recovery and increased yield. New shoots are developed from the young woods from a larger area per bush that forms plucking table. Because of improper bush management (hard plucking) rapid decline in yield, a form of light skiffing is necessitated in order to maintain normal pruning cycle or to extend pruning cycle length (Kulasegaram et al 1988).

Conclusion

Overall results suggested that yield increases from pruning and reaches to a maximum in the 2nd year for TRI-2025 and in 2nd and 3rd years for DT-1. Thereafter, a gradual decline of yield with ageing was observed for both clones. Yield reduction was mainly associated with the reduction of shoot number per unit area, size of the shoot (reduced inter-nodal length and leaf size), photosynthetic rate, proportional sunlit leaf area, and percentage of active shoot number for both clones. Thermal time required for shoot growth and the banji shoot (growth retarded shoot) percentage also increased significantly resulting in gradual reduction in productivity for both clones. Photosynthesis rate was similar for both clones, but the productivity of TRI-2025 from pruning was greater across all years compared to DT-1. This may be attributed to the production of higher percentage of shoots per unit area, faster growth rate of shoots, and the larger shoot size with greater inter-nodal length compared to DT-1. Light skiffing at the 4th and 5th year of pruning enhanced the productivity by 29% and 42% respectively. Therefore, light skiffing at the 5th year of pruning may be recommended to prolong the pruning cycle while obtaining comparable yield.



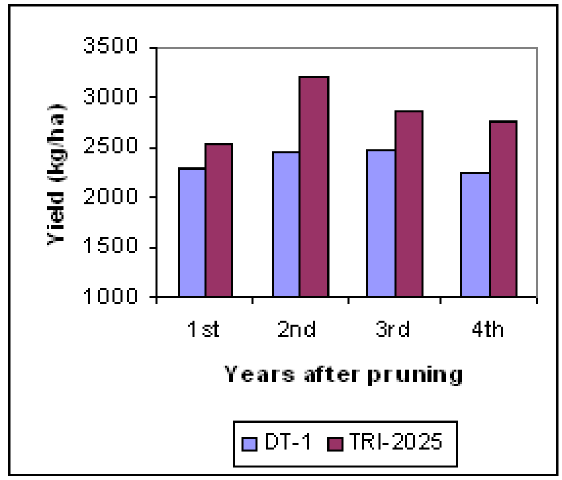


Fig.1. Leaf photosynthesis rate of tea clones at different years after pruning

Fig.2. Annual black tea production of tea clones at different years after pruning

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References

Barua DN (1989) Science and practice in tea culture. Tea Research Association. Calcutta. pp 305.

Central Bank Annual Report of Sri Lanka (2001). Colombo, Sri Lanka.

Kulasegaram S, Kathiravetpillai A and Shanmugarajah V (1988). Approaches to higher tea productivity through proper bush management. Sri Lankan J. of Tea Science Conference Issue (19-21, January 1988), Colombo, Sri Lanka. pp 157-161.

Mwakha E (1985) Tea shoots growth in Kenyan highlands. Tea. 6 (1), 5-13.

Odhiambo HO (1986) Factors affecting tea shoot growth: A review. Tea. 7 (2), 79-87.

Squire GR (1985). Ten years of tea physiology. Tea 6 (2), 43-48.

Tanton TW (1982). Environmental factors affecting the yield of tea (*Camellia sinensis* L.) I: Effect of air temperature. Exp. Agric. 18, 47-52

Tea Bulletin (1999). Tea Research Institute of Sri Lanka. 16(1&2), 41.

http://www.arabica.com/tea/article00054/default.asp