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# Effect of Integrated Nutrient Management on Pruning Recovery in Tea (*Camellia* sp.)

**S. Easwaran [a++], M. Marimuthu [a#*] and V. Guhan [a†]**

*[a] ICAR-Krishi Vigyan Kendra, Sirugamanai, Tiruchirappalli-639115, India.*

***Authors' contributions***

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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***Original Research Article***

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## ABSTRACT

The Experiment was conducted at Parry Agro Industries Ltd., Valparai, Coimbatore district in two varieties of tea *viz*., Assam jat and ATK clone. Totally eighteen treatments with different combinations of 100, 75, 62.5 and 50 per cent of the recommended doses of fertilizers along with DCC and biofertilizers. The DCC at the rate of three and six tonnes $ha^{-1}$ and biofertilizers *viz.,* VAM, *Azospirillum* and Phosphobacteria each @ 40 kg $ha^{-1}$ were given annually. Bud break and time taken for tipping were earliest in the plots receiving higher dose of DCC (6 $t/ha^{-1}$) along with biofertilizers (50 kg $ha^{-1}$) irrespective of levels of inorganic fertilizers ($T_4$, $T_5$, $T_8$, $T_{12}$ and $T_{16}$) in both the varieties. Maximum number of buds and tipping weight, pruning index and starch content were higher in treatments consisting higher level of DCC (6 $t/ha^{-1}$) and biofertilizers (40 kg $ha^{-1}$) along with higher levels of inorganic fertilizers (100% and 75% of recommended dose).

[++] *Subject Matter Specialist (Horticulture);*
[#] *Subject Matter Specialist (Food Science and Nutrition);*
[†] *Subject Matter Specialist (Agrometeorology);*
**Corresponding author: E-mail: muthufsn@ymail.com;*

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## 1. INTRODUCTION

Tea bushes are pruned at periodical intervals to revitalize its vegetative vigour, revive gross morphology and physiology and maintain an operable form and size of the bush. The regeneration of bush following pruning is solely supported by the carbohydrates reserves available in stems and roots which would depend upon the nutrients applied, no of shoots retained etc. Although, the usage of bush tea has declined over time due to the availability of commercially produced teas, the plant still has economic potential as an herbal medicine [1]. Pruning is one of the most important operations, next to plucking, which directly determines the productivity and quality of tea bushes [2]. Yilmaz et al. [3] reported less yields in tea harvested 50 cm above the ground in the first year, with yields increasing in the subsequent second and third years. Thus, pruning increases tea yields in the long term. In the present study, nutrient management through the use of organic manures in the form of Digested Coirpith Compost (DCC) and biofertilizers like *Azospirillum brasilense*, Vesicular Arbuscular Mycorrhizae (VAM) and phosphobacteria has been taken up during one complete pruning cycle to assess their influence on the pruning recovery of tea bushes.

## 2. MATERIALS AND METHODS

The investigation was carried out in Parry Agro Industries Ltd., Valparai, Coimbatore district to study the effect of digested coirpith compost (DCC) and biofertilizers on pruning recovery in two varieties of tea *viz*., Assam jat and ATK clone. Totally eighteen treatments with different combinations of 100, 75, 62.5 and 50 per cent of the recommended doses of fertilizers along with DCC and biofertilizers (Table 1) were involved. The experiment was laid out in RBD with three replications. Each treatment unit consisted of 100 bushes. The DCC at the rate of three and six tonnes $ha^{-1}$ and biofertilizers *viz.,* VAM, *Azospirillum* and Phosphobacteria each @ 40 kg $ha^{-1}$ were applied annually. The tea bushes in the experimental field were pruned during August 1997 and the treatments were appiled from October 1997 onwards. Following the end of one pruning cycle, observations on pruning recovery, including pruning index, time for bud emergence, number of buds per bush, time for tipping, tipping weight, and starch content, were made during the next pruning year in August 2001. Starch content was recorded 15 days before pruning and 60 days after pruning as per the method described by Sadasivam and Manickam [4] and expressed in per cent. Pencil thick root samples were collected from five randomly selected tea

**Table 1. Treatment details**

| Treatments | Details |
|---|---|
| $T_1$ | Recommended dose of inorganic fertilizers (Estate practice or control) |
| $T_2$ | $T_1$ + Digested Coirpith Compost (DCC) alone @ 3 t/ha |
| $T_3$ | $T_1$ + Digested Coirpith Compost (DCC) alone @ 6 t/ha |
| $T_4$ | $T_2$ + Biofertilizers |
| $T_5$ | $T_3$ + Biofertilizers |
| $T_6$ | 75% of $T_1$ |
| $T_7$ | 75% of $T_1$ + DCC @ 3 t/ha + Biofertilizers |
| $T_8$ | 75% of $T_1$ + DCC @ 6 t/ha + Biofertilizers |
| $T_9$ | 75% of $T_1$ + Biofertilizers alone |
| $T_{10}$ | 62.5% of $T_1$ |
| $T_{11}$ | 62.5% of $T_1$ + Biofertilizers |
| $T_{12}$ | 62.5% of $T_1$ + DCC @ 6 t/ha + Biofertilizers |
| $T_{13}$ | 62.5% of $T_1$ + Biofertilizers alone |
| $T_{14}$ | 50% of $T_1$ |
| $T_{15}$ | 50% of $T_1$ + DCC @ 3 t/ha + Biofertilizers |
| $T_{16}$ | 50% of $T_1$ + DCC @ 6 t/ha + Biofertilizers |
| $T_{17}$ | 50% of $T_1$ + Biofertilizers alone |
| $T_{18}$ | $T_1$ + Biofertilizers alone |
| Biofertilizers - VAM, *Azospirillum* and Phosphobacteria each @ 40 kg/ha | |

bushes, dried in a laboratory oven at 70°C and powdered using Wiley mill. Powdered (40 to 60 mesh) sample was used for the determination of starch.

## 3. RESULTS AND DISCUSSION

In both ATK and Assam jat, significant differences were observed among the treatments for characters *viz*., time taken for bud break, number of buds per bush, time taken for tipping, tipping weight per plot and pruning index (Table 2). Among the treatments, bud break and time taken for tipping were earliest in the plots receiving higher dose of DCC (6 t/ha$^{-1}$) along with biofertilizers irrespective of levels of inorganic fertilizers ($T_4$, $T_5$, $T_8$, $T_{12}$ and $T_{16}$) in both the varieties. Assam jat generally recorded relatively a longer time for bud break and time taken for tipping as compared to ATK. Number of buds and tipping weight, pruning index and starch content were higher in treatments consisting higher level of DCC and biofertilizers along with higher levels of inorganic fertilizers (100% and 75% of recommended dose).

**Table 2. Effect of digested coirpith compost and bio fertilizers on pruning recovery in tea varieties**

| Treatments | Time taken for bud break (days) | | Number of buds per bush | | Time taken for tipping (days) | | Tipping weight per plot (days) | | Pruning Index (kg/cm$^2$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ATK | Assam | ATK | Assam | ATK | Assam | ATK | Assam | ATK | Assam |
| $T_1$ | 26 | 28 | 265 | 275 | 86 | 92 | 0.222 | 0.239 | 3.34 | 1.67 |
| $T_2$ | 25 | 26 | 274 | 286 | 82 | 87 | 0.304 | 0.269 | 3.72 | 1.98 |
| $T_3$ | 25 | 26 | 285 | 298 | 81 | 85 | 0.307 | 0.33 | 3.89 | 1.99 |
| $T_4$ | 23 | 24 | 310 | 314 | 77 | 82 | 0.278 | 0.305 | 4.00 | 2.15 |
| $T_5$ | 22 | 23 | 325 | 345 | 77 | 78 | 0.275 | 0.337 | 4.08 | 2.29 |
| $T_6$ | 27 | 28 | 272 | 270 | 84 | 92 | 0.255 | 0.291 | 3.34 | 1.55 |
| $T_7$ | 24 | 25 | 295 | 285 | 78 | 82 | 0.295 | 0.346 | 3.76 | 2.13 |
| $T_8$ | 23 | 25 | 328 | 320 | 77 | 78 | 0.340 | 0.357 | 4.23 | 2.15 |
| $T_9$ | 24 | 26 | 298 | 296 | 79 | 82 | 0.287 | 0.269 | 3.42 | 1.87 |
| $T_{10}$ | 26 | 27 | 248 | 268 | 84 | 90 | 0.286 | 0.274 | 2.94 | 1.55 |
| $T_{11}$ | 24 | 25 | 284 | 281 | 79 | 84 | 0.245 | 0.266 | 3.73 | 1.94 |
| $T_{12}$ | 24 | 24 | 292 | 290 | 77 | 80 | 0.312 | 0.345 | 3.84 | 2.13 |
| $T_{13}$ | 25 | 24 | 276 | 286 | 82 | 86 | 0.273 | 0.298 | 3.25 | 1.85 |
| $T_{14}$ | 27 | 27 | 268 | 267 | 87 | 94 | 0.286 | 0.281 | 2.94 | 1.54 |
| $T_{15}$ | 25 | 25 | 284 | 274 | 80 | 84 | 0.293 | 0.315 | 3.34 | 1.76 |
| $T_{16}$ | 24 | 24 | 286 | 286 | 79 | 81 | 0.294 | 0.343 | 3.62 | 1.92 |
| $T_{17}$ | 25 | 25 | 270 | 276 | 82 | 87 | 0.284 | 0.259 | 2.82 | 1.75 |
| $T_{18}$ | 25 | 26 | 285 | 295 | 84 | 88 | 0.298 | 0.369 | 3.61 | 1.89 |
| S.Ed | 0.515 | 0.569 | 5.460 | 5.760 | 1.578 | 1.750 | 0.051 | 0.052 | 0.163 | 0.097 |
| CD (P=0.05) | 1.41 | 1.156 | 11.140 | 11.700 | 3.200 | 3.550 | 0.103 | 0.105 | 0.3313 | 0.198 |

**Table 3. Effect of digested coirpith compost and biofertilizers on the starch content (%) of dried roots in tea varieties**

| Treatment | ATK | | | Assam jat | | |
|---|---|---|---|---|---|---|
| | 15DBP | 60DAP | % Decrease | 15DBP | 60DAP | % Decrease |
| $T_1$ | 20.46 | 16.16 | 21.02 | 19.21 | 16.02 | 16.61 |
| $T_2$ | 22.22 | 17.24 | 22.41 | 21.09 | 17.20 | 18.44 |
| $T_3$ | 22.24 | 17.28 | 22.30 | 21.21 | 17.22 | 18.81 |
| $T_4$ | 22.48 | 17.38 | 22.69 | 21.36 | 17.32 | 18.91 |
| $T_5$ | 22.85 | 17.47 | 23.54 | 21.67 | 17.45 | 19.47 |
| $T_6$ | 20.37 | 16.08 | 21.06 | 19.07 | 16.02 | 15.99 |
| $T_7$ | 22.52 | 17.35 | 22.96 | 21.48 | 16.85 | 21.55 |
| $T_8$ | 22.88 | 17.42 | 23.86 | 21.85 | 17.13 | 21.60 |

| Treatment | ATK | | | Assam jat | | |
|---|---|---|---|---|---|---|
| | 15DBP | 60DAP | % Decrease | 15DBP | 60DAP | % Decrease |
| $T_9$ | 22.28 | 17.25 | 22.58 | 21.31 | 17.25 | 19.05 |
| $T_{10}$ | 20.34 | 16.12 | 20.75 | 18.88 | 16.04 | 15.04 |
| $T_{11}$ | 22.34 | 17.32 | 22.47 | 20.65 | 17.30 | 16.22 |
| $T_{12}$ | 22.44 | 17.38 | 22.55 | 20.98 | 17.40 | 17.06 |
| $T_{13}$ | 22.16 | 17.24 | 22.20 | 20.32 | 17.22 | 15.26 |
| $T_{14}$ | 20.28 | 16.10 | 20.61 | 19.01 | 16.01 | 15.78 |
| $T_{15}$ | 21.82 | 17.24 | 20.99 | 20.68 | 17.29 | 16.39 |
| $T_{16}$ | 22.06 | 17.28 | 21.67 | 20.84 | 17.38 | 16.60 |
| $T_{17}$ | 22.04 | 17.17 | 22.10 | 20.28 | 17.24 | 14.99 |
| $T_{18}$ | 22.30 | 17.25 | 22.65 | 21.33 | 17.28 | 18.99 |
| S.Ed | 0.387 | 0.312 | -- | 0.395 | 0.289 | -- |
| CD (P=0.05) | 0.786 | 0.633 | -- | 0.806 | 0.588 | -- |

*DBP – Days Before Pruning DAP – Days After Pruning*

The positive response of plants to DCC application along with biofertilizers may therefore be attributed to better uptake of nitrogen and water besides better storage of reserves in roots which in turn promoted the bud break and earlier growth and development of new shoots after pruning. If the tea bushes are left completely devoid of leaves at the time of pruning, they are unable to make use of the raw materials necessary for growth and are inevitably dependent on the reserves of elaborated food starch which they have accumulated for their recovery [5]. Hence in the present study, the starch reserves in the roots were just analyzed before and following pruning and the results showed that combined application of DCC and biofertilizers significantly registered maximum starch content both 15 days before pruning and 60 days after pruning, confirming the key role of reserved starch material in the recovery of bushes after pruning in tea. Higher accumulation of starch in these bushes might be due to the better physiological status of the plant enhanced by the application of DCC and biofertilizers.

The maximum tipping weights and number of buds, earlier tipping and bud break were also recorded in treatments, which received DCC and biofertilizers that coincided with the highest initial carbohydrate levels influencing the recovery. The level of total carbohydrates in the root declined steeply after pruning. The declining trend continued up to 45 days after pruning. This decreasing trend in the root carbohydrate might be because of the upward translocation of carbohydrate for bud break and shoot growth and development. The slight increasing trend in the root carbohydrate levels observed during 45 days after pruning could be attributed to downward translocation of assimilates produced by newly expanding leaves [6].

## 4. CONCLUSION

The present experiment aims to highlighting the effect of integrated nutrient management on pruning recovery in Tea. It is evident that recovery of the tea bushes completely depends upon the starch reserves in the roots which could be positively correlated with nutrients available to the plants.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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