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EFFECTS OF DIFFERENT TYPES OF COMPOST ON YIELD AND YIELD RELATED PARAMETERS OF YOUNG TEA [*Camellia sinensis* (L.) O. Kuntze]

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Abstract

A field experiment was carried out to observe the suitability of alternate sources of organic manure for application in the planting pit during tea plantation. Generally, it is advised to use 2 kg well decomposed cowdung with 30 g TSP and 15 g MOP in the pit. In this experiment, we used three different types of compost as treatment viz. Vermicompost (T_1), Farm yard compost (T_2), Water hyacinth compost (T_3) and Decomposed cowdung as the Control (T_4) along with recommended chemical fertilizers. Growth, development and yield related different parameters were observed and recorded during the first five years after planting. Base diameter, number of branches and fresh weight per plant were not significantly different for treatments at decentering stage but in the successive years these were varied significantly with treatments. At the end of 5th year after planting, highest number of branches found in T_4 (21) and found statistically similar with T_1 (18) and T_3 (18) whereas the lowest was found in T_2 (16). Similarly, base diameter was maximum in T_4 (33.0 mm) which was statistically similar with T_3 (32.9 mm) and T_1 (32.5 mm) but different with T_2 (28.9 mm). However, yield of tea was not significantly different for treatments.

Keywords: Compost, Branch number, Base diameter, Young/Immature tea, Yield

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Introduction

Tea [*Camellia sinensis* (L.) O. Kuntze] is processed from its tender shoots which is prevalent and healthy beverage because of its excellent value and high palatability (Ma et. al., 2019). Tea is consumed worldwide largely for its extensive variety of bioactive compounds, like amino acids, catechins, polyphenols, caffeine, and terpenes (Jiang et. al., 2020). There is now a global shift to environmentally safe and economically viable alternatives for good production rather than using inorganic fertilizers. Therefore, to fulfill the upward consumption demand of tea, we need to give emphasize to increase the production within a small area. In developing countries the strategy for improving agricultural production through supplementing nitrogen and phosphorous by microbial processes should be considered. Through applying the biological fertilizers it can be accomplished (Ambachew & Fatih, 2018). Production of tea dependents on several factors comprising of those that are inherent in the plant and those exerted on the tea crop by nature including pests and diseases; soil and climatic conditions and human through crop husbandry and cultural managements. In tea plantation fertilizer is one of the major agro-inputs that contribute to the productivity and cost of production. To achieve expected production of tea, a well-balanced fertilization throughout the year is the key contributing factor and it is important for proper maintenance of the health of tea bushes. The combined use of organic and inorganic fertilizers will ensure that the problems associated with the use of either organic or inorganic fertilizers are greatly reduced as the combination of organic and inorganic fertilizers complement each other (Anjaneyulu & Bhattacharjee, 2019).

As a source of nutrients, manure is using from the very beginning of cultivation. All the necessary macronutrients and many micronutrients can be added through the application of manure while increasing organic matter. In soil fertility enrichment and for supplying primary, secondary and micronutrients for crop production application of cowdung, poultry manure and vermicompost may play a vital role. Poultry manure contains high amount of secondary and micronutrients (1.6%N, 1.5%P and 0.85%K) while cowdung contains 0.5-1.5% N, 0.4-0.8% P, 0.5-1.9% K and other nutrients in small quantity (Aktar et al., 2020). On the other hand, vermicompost is rich in NKP (nitrogen 2-3%,

potassium 1.85-2.25% and phosphorus 1.55-2.25%), micronutrients, beneficial soil microbes and also contain 'plant growth hormones & enzymes (Sinha et al., 2009). There are some evidences that describes, Vermicompost could act as 'miracle growth promoter & also plant protector' from pests and diseases. While the traditional compost fails to supply the necessary amount of macro and micro nutrients including the vital NKP to plants in shorter time and in that case vermicompost retains nutrients for long time (Sinha et al., 2009). In tea cultivation, use of vermicompost has become popular and it is giving tremendous results in VP nursery and the producers getting their expected outcomes.

Even a decade earlier, tea was an important commodity of international trade for Bangladesh, but during the recent years it had a little share to export due to high domestic consumption. In 2021, total tea production of the country was 96.56 million kg (BTB, 2022) and consumption was also almost the similar. To meet up the internal consumption as well as for increasing the share for export of tea, Bangladesh Tea Board has taken a project in 2018 entitled "Road map for the tea industry of Bangladesh" and it's execution is going on. Main target of the project is to produce 140 million kg made tea by 2025. One of the main tools of the project is to extend and infill the tea area with high yielding varieties which is already initiated. It is also needed to mention here that having cultivable land for tea, extension of 2.5% tea area is mandatory for such types of gardens.

The critical value of organic matter for tea soil in Bangladesh has been fixed at 1% (Alam, 1999). However at present, its actual status is less than that. Leaching and surface run-off during monsoon season might be the prime reasons for poor nitrogen and organic matter content in tea soils of North Sylhet and Chittagong (Sana, 1989). Tea, being a perennial crop is recommended to apply certain amount of organic manures and fertilizers in pit during the time of plantation. Hence during the plantation of tea in Bangladesh, it is advised to mix 2 kg decomposed cowdung, 30 g Triple superphosphate (TSP) and 15 g Muriate of potash (MOP) with top soil for each planting pit (Alam, 2003).

However, sometimes decomposed cowdung is not available in all the tea growing area. As an alternative source of cowdung many tea growers are interested to use different organic manures produced from different origin depending on its availability adjacent to the tea growing area. Hence, the experiment was conducted to know the effects of different composts on young tea. On the basis of availability of organic manures in the growing area, vermicompost, farm-yard compost and compost prepared from water hyacinth were used as treatments in comparison with the control (decomposed cowdung).

Materials and Methods

The experiment was conducted at the Bangladesh Tea Research Institute (BTRI) Main Farm, Srimangal and the area was completely flat ($24^0$29'N, $91^0$75'E and 29 m amsl). Required data were collected after planting to its formative pruning stage. One year old BT2 clonal tea plants were collected from BTRI Vegetative Propagation (VP) nursery and planted in the main field on September, 2017. In the planting pit, different types of compost were applied as treatments. According to BTRI, 2 kg well decomposed cowdung with 30 g TSP and 15 g MOP per pit during tea plantation showed the better result. However, in this experiment three different composts were used as treatments and cowdung used as control. Vermicompost was collected from vermicompost unit of Soil Science Division, Bangladesh Tea Research Institute and others were prepared at the main farm of BTRI. Randomized Complete Block Design was followed to conduct the experiment with four replications. It was double hedge plantation system and spacing was 60cm × 60cm × 120cm. In each plot there were 20 BT2 clonal tea plants.

The experiment continued from 2017 to 2022 that means from planting to frame formation pruning. During this period, all the intercultural operations including manuring, pruning, tipping, disease and pest management, etc. were continued according to BTRI recommendation (Alam, 2003) which were similar for each treatment. During the entire period of experiment, data collected regularly. During the decentering in the 1st week of May 2018, base diameters of main stems were recorded. Number of branches emerged as primaries after decentering were also recorded at the end of 2018. First frame

formation pruning (FFP-1) accomplished in the experimental field at the last week of December 2018. Required data related to agronomy like harvested green leaf yield, branch number etc. were collected in 2019. At the beginning of 2020 tea plants of the experiment were pruned as skiff condition and after attaining the tipping height (24 inches) green leaf as yield from each plot was collected. At the end 2020, Second frame formation pruning (FFP-2) was done for fourth year of plants age at 18 inches height from ground. After pruning, number of branches and base diameter of tea plants were recorded for every treatment. After attaining the tipping height (28 inches) and during that year (2021) green leaf from each plot was harvested. Age of tea plants was five and it was the final year as young tea. Hence at the beginning of 2022, tea plants of the experiment were pruned as skiff condition at 28 inches and after attaining the tipping height (30 inches) and throughout the year green leaf from each plot was collected. At the end of the season, first light pruning (LP) was done at 22 inches height of tea plants. Then number of branches and base diameter of tea plants were recorded for every treatment. Collected growth parameters and yield data were analyzed properly.

Results and Discussion

After plantation, decentering was done at the age of 8 months of tea plants. During the pruning and few weeks after the pruning, data were collected on different growth parameters viz. base diameter, fresh weight of the plant and number of branches emerged after pruning per plant, were observed non-significant for treatments at p=0.05 (Table 1).

Table 1. Effect on different growth parameters after decentering.

Treatments	Base diameter	Plant fresh weight	No. of branches per plant
	(mm)	(g)	
T_1 (Vermicompost)	8.5	54.25	6
T_2 (Farm-yard compost)	9.5	50.75	6
T_3 (Water hyacinth compost)	8.5	53.25	7
T_4 (Decomposed cowdung, Control)	9.0	51.75	7
LSD (P=0.05)	2.5	13.25	2.0
CV (%)	18	16	20

At the end of 2nd year after plantation FFP-1 was done and different morphological data especially on growth parameters were collected during the time of pruning and few weeks after the pruning. Base diameter of plant found significantly different for treatment at p=0.05 while the number of branches per plant was showed non-significant effect (Table 2). Both the base diameter and number of branches per plant were minimum in T_2 which was treated with Farm-yard compost.

Table 2. Effect on different growth parameters at the time of FFP1.

Treatments	Base diameter	No. of branches per plant
	(mm)	
T_1 (Vermicompost)	18.9ab	7.3b
T_2 (Farm-yard compost)	16.6b	7.0b
T_3 (Water hyacinth compost)	18.3ab	8.0ab
T_4 (Decomposed cowdung, Control)	19.1a	9.0a
LSD (P=0.05)	2.37	1.6
CV (%)	11	17

Within column values followed by different letter (s) are significantly different by DMRT (p≤ 0.05)

During the successive years (3rd and 4th year of young tea plants), pruning was done following BTRI recommendation (Alam, 2003) and data were collected regularly. At this stage, collected data particularly the yield was collected and found non-significant for treatments. At the final year of the experiment i.e. 5th year of young mature tea plants, data were collected on harvested green leaf yield which was converted into made tea yield with 23% recovery (De Costa et al., 2007). Yield was not

significant for treatments at p=0.05 (Figure 1). However, number of branches per plant and base diameter of the main stem (collar zone) were found significantly different for treatments after the formative pruning. Maximum number of branches per plant and base diameter were observed in T_4 which was similar with T_3 and T_1 but different with T_2 (Table 3).

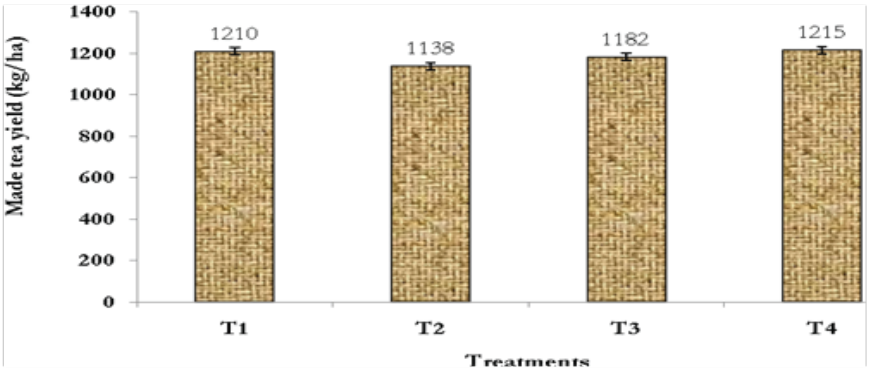

Figure 1. Made tea (kg ha^{-1}) under different treatments at fifth year.

Table 3. Effect on number of branches and base diameter at fifth year (after first light pruning)

Treatments	Base diameter (mm)	No. of branches per plant
T_1 (Vermicompost)	32.5ab	18ab
T_2 (Farm-yard compost)	28.9b	16b
T_3 (Water hyacinth compost)	32.9a	18ab
T_4 (Decomposed cowdung, Control)	33.0a	21a
LSD (P=0.05)	3.7	3
CV (%)	10	15

Within column values followed by different letter (s) are significantly different by DMRT (p≤ 0.05)

Conclusion

Findings of present study showed that apart from decomposed cowdung, compost produced from different organic sources can be applied in pit during the plantation. Particularly in the areas where prevailing scarcity of cowdung, vermicompost and compost produced from water hyacinth can be used extensively during the plantation of tea in addition with recommended doses of chemical fertilizers.

Further research direction

Similar study can be continued in collaboration with Soil Science Division to observe the soil characteristics, soil microbe status, etc. before and after the experiment.

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