Original Research Article

Effect of Different Types of Pruning Operations on Yield and Quality of Tea

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ABSTRACT

Aims: Pruning is the cutting of branches of a tea bush at predetermined height and at a specified interval in order to reinvigorate and bring tea bushes within reach of the pluckers, which directly related to the productivity and quality of tea. In Bangladesh, Three and four year pruning cycles were the conventional recommendations for the tea plantation. In this experiment, along with BTRI recommended four types of pruning operations (LP, DSK, MSK and LSK), two more types of pruning operations such as: UP (Unprune) and LoS (Level of Skiff) were considered as treatments. This experiment was conducted with two main objectives: to evaluate the yield and yield related parameters of tea due to different types of pruning operations as well as to find out the effect of pruning operations on organoleptic quality of black tea.

Study design, Place and Duration of Study: This experiment was conducted 'D2 Thall' area at the main research farm of Bangladesh Tea Research Institute (BTRI) from December 2017 to November 2019. The experimental design was Randomized Completely Block Design (RCBD) with six treatments and three replications.

Methodology:
The treatments are denoted as T1 (UP: Unpruned) control, T2 (LP: Light Pruning), T3 (DSK: Deep Skiffing), T4 (MSK: Medium Skiffing), T5 (LSK: Light Skiffing) and T6 (LoS: Level of Skiffing) respectively. Data were collected under the following parameters:
a) Number of plucking point or pluckable shoot/bush in each plucking
b) Fresh weight (g) of 100 shoots (three leaves and a bud)
c) Oven Dry weight (g) of 100 shoots (three leaves and a bud) to calculate Dry Matter Content
d) Green leaf weight (kg) to calculate Yield of each treatment
e) Number of plucking round to calculate Yield gap of each treatment
f) Black Tea Quality of each treatment by Organoleptic Tasting Method.

Results: It was found that, number of plucking points/pluckable shoot and yield were found significantly high in T6 (Level of Skiffing), T5 (Light Skiffing) and T1 (Unpruned) than the other treatments. But in terms of tea quality, lowest quality tea was found in T1 (Unpruned), T6 (Level of Skiffing) and T5 (Light Skiffing) treatment. So, it can be concluded that, 'Skiff Pruning' or 'Unprune' technique had positive effect on yield but the quality of these technique were poor in comparison with other treatments. T2 (Light Pruning) treatment gave more tender and fresh shoot than the other treatment. For this reason, dry matter was low in T2 (Light Pruning) treatment but tea quality was much better than the other pruning technique.

Conclusion: Pruning has positive or negative effect on yield and quality of tea. 'Skiff Pruning' or 'Unprune' has positive effect on yield but the quality of is poor than the other treatments. Best Quality tea can be produced from Light Pruning tea section because of having more tender and fresh shoot than other treatments.

1. INTRODUCTION

Tea is a popular beverage made from the leaves of evergreen shrub or tree (*Camellia sinensis*). Under natural conditions, a tea plant grows to a small tree but it is configured into a bush by sequential pruning and other silvicultural practices, *viz*, tipping, plucking and by harvesting the optimum vegetative produce [1]. Pruning is one of the most important operations, next to plucking, which directly determines the productivity and quality of tea bushes [2]. Pruning is the cutting of branches of a tea bush at predetermined height and at a specified interval in order to reinvigorate and bring tea bushes within reach of the pluckers. Pruning is inevitable to check the apical dominance and keep the bushes in vegetative stage and to divert the energy towards production of leaves. It also leads to enhance branching and hence a greater number of tender leaves [3].

Tea plants are pruned to obtain a given table form and height, to eliminate unnecessary and diseased branches, to rejuvenate the tea plants, and to obtain healthier and better quality tea plants as well as to achieve higher crop yield [4]. Pruning was also found to affect the quality of tea. All the pigment contents of black tea, except chlorophyll, were found to be higher in pruned tea leaf then unpruned tea, thus enhancing the quality of made tea [5]. The precursors responsible for tea quality, such as polyphenols, were found to increase in the first year and thereafter declined in content with time from pruning [6].

In Bangladesh, Three and four year pruning cycles were the conventional recommendations for the tea plantation [7]. With the change of time, like many other tea growing countries, from long term results, four-year pruning cycle i.e. LP (Light Pruning), DSK (Deep Skiffing), MSK (Medium Skiffing) and LSK (Light Skiffing) have been adopted to increase the productivity of tea [8]. In some tea growing countries two different pruning operations were used in some cases, named as UP (Unprune) and LoS (Level of Skiff). In this experiment, along with these BTRI recommended four types of pruning operations (LP, DSK, MSK and LSK), two more types of pruning operations such as, UP (Unprune) and LoS (Level of Skiff) were considered as treatments. This experiment was conducted with two main objectives: to evaluate the yield and yield related parameters of tea due to different types of pruning operations as well as to find out the effect of pruning operations on organoleptic quality of black tea.

2. MATERIALS AND METHODS

This experiment was conducted 'D2 Thall' area at the main research farm of Bangladesh Tea Research Institute (BTRI) Sreemangal, Moulvibazar-3210 from December 2017 to November 2019. The experimental design was Randomized Completely Block Design (RCBD) with six treatments and three replications. The treatments are denoted as T1 (UP: Unpruned) control, T2 (LP: Light Pruning), T3 (DSK: Deep Skiffing), T4 (MSK: Medium Skiffing), T5 (LSK: Light Skiffing) and T6 (LoS: Level of Skiffing) respectively. The experiments was conducted in a single same aged mature section of 'BT2' tea variety for uniform result. Other tea culture operations such as fertilizer application, weeding, pesticide application etc. were carried out according to the recommendation of BTRI.

Data were collected normally weekly intervals. The experimental data was analyzed with the help of Mstat C software. Data were collected under the following parameters:
- g) Number of plucking point or pluckable shoot/bush in each plucking
- h) Fresh weight (g) of 100 shoots (three leaves and a bud)
- i) Oven Dry weight (g) of 100 shoots (three leaves and a bud) to calculate Dry Matter Content
- j) Green leaf weight (kg) to calculate Yield of each treatment
- k) Number of plucking round to calculate Yield gap of each treatment in a particular year
- l) Black Tea Quality of each treatment by Organoleptic Tasting Method

Before each plucking, number of plucking points were counted from a tea bush for each treatment. To obtain dry matter content, at first freshly plucked 100 shoots having three leaves and a bud from each treatments were weighed. Shoots were then dried treatment wise at $80+2^0C$ for 72 hours in a microwave oven. For obtaining good quality of CTC Black tea, the "two leaves and a bud" were processed. At first leaves were withered for 1 days (12-18 hours), then crush & oxidised for 20-30 minutes and immediately

dried at 82-104^{0}C for 30 minutes for bringing down the moisture at 3%. The liquor was prepared by pouring boiling water in a mug of a capacity of 142 ml (about 0.25 pint) in which 2.5g tea was contained. After 5 minutes of brewing, the liquor was poured into a bowl and the infused leaf was shaken from the mug into the inverted lid, which was placed on top of the mug [9]. The liquor was then tasted and assessed by organoleptic method and scored numerically on the basis of liquoring characteristics. Tea quality scoring was done within 50 points where 10 points for Infused leaf, 10 points for Liquor colour, 10 points for Briskness, 10 points for Strength and 10 points for Creaming down [10].

3. RESULTS AND DISCUSSION

3.1 Effect of Pruning Types on Number of Plucking Points (pluckable shoot/bush in each plucking)

The plants were pruned according to the treatments. From Table 01, it was found that pruning types has significant effect on number of plucking points. It was observed that T6 (level of skiff) given highest significant number of plucking points/bush (113.82) as compare to the other treatments and T2 (Light Pruning) given lowest number of plucking points/bush (37.67).

Table 01. Number of Plucking Points/Bush

Treatments	Plucking points
T1 (Unpruned)- Control	100.81 ab
T2 (Light Pruning)	37.67 d
T3 (Deep Skiffing)	58.63 c
T4 (Medium Skiffing)	98.22 b
T5 (Light Skiffing)	102.08 ab
T6 (Level of Skiffing)	113.82 a
LSD at 5% level of significance	12.18
Critical Value%	21.54%

The mean difference is significant at P<0.05. Letters indicate values within the same column that are either significantly different (when the letters are different) or not (when the letters are the same) using DMRT at P < 0.05

3.2 Effect of Pruning Types on Fresh Weight (g) of 100 Shoot (3 leaves and a bud):

Different types of pruning has significant effect on fresh weight (g) of 100 shoot (Table 02). It was observed that due to pruning types tea shoots showed different fresh weight (g). From the analysis it was found that T2 (Light Pruning) given highest 100 shoot fresh weight (g) (187.37g) as compare to the rest of the treatments and T6 (level of skiff) given lowest fresh weight (150.3g).

Table 02. Fresh weight (g) of 100 shoot (three leaves and a bud)

Treatments	Fresh Weight (g) of 100 shoot (3 leaves and a bud)
T1 (Unpruned)- Control	153.4 d
T2 (Light Pruning)	187.37 a
T3 (Deep Skiffing)	176.40 b
T4 (Medium Skiffing)	162.67 c
T5 (Light Skiffing)	161.09 c
T6 (Level of Skiffing)	150.30 d
LSD at 5% level of significance	9.98

The mean difference is significant at P<0.05. Letters indicate values within the same column that are either significantly different (when the letters are different) or not (when the letters are the same) using DMRT at P < 0.05

3.3 Effect of Pruning Types on Dry Matter Content of Shoot:

Dry Weight (g) of 100 Shoot (three leaves and a bud) from each treatment was recorded to calculate the dry matter content. From the analysis of data (Table 03) it was found that pruning types had significant effect on dry matter content in shoot. It was observed that T2 (Light Pruning) and T3 (Deep Skiffing) given lowest dry weight while T5 (Light Skiffing) given highest dry matter content that is 42.53 a.

Table 03. Dry Matter Content of 100 Shoot

Treatments	Dry Weight (g) of 100 Shoot
T1 (Unpruned)- Control	38.09 b
T2 (Light Pruning)	35.78 c
T3 (Deep Skiffing)	35.53 c
T4 (Medium Skiffing)	37.91 b
T5 (Light Skiffing)	42.53 a
T6 (Level of Skiffing)	42.04 ab
LSD at 5% level of significance	5.61

The mean difference is significant at P<0.05. Letters indicate values within the same column that are either significantly different (when the letters are different) or not (when the letters are the same) using DMRT at P < 0.05

3.4 Effect of Pruning Types on Yield of tea under different types of pruning:

From the analysis result of yield data, it was observed that significantly highest average yield was obtained in the treatment T6 (LoS, 3376.7 kg/ha) and lowest average in the treatment T2 (LP, 2080 kg/ha) and these differences were due to the differences in given pruning operations (Table 04).

Table 04. Yield of tea under different types of pruning

Treatments	Yield (kg/ ha)
T1 (Unpruned)- Control	3046.71 bc
T2 (Light Pruning)	2080.02 e
T3 (Deep Skiffing)	2646.73 d
T4 (Medium Skiffing)	2923.36 c
T5 (Light Skiffing)	3263.34 b
T6 (Level of Skiffing)	3376.79 a
LSD at 5% level of significance	109.18

The mean difference is significant at P<0.05. Letters indicate values within the same column that are either significantly different (when the letters are different) or not (when the letters are the same) using DMRT at P < 0.05

3.5 Effect of Pruning Types on Yield Gap compared to control (Unprune):

Pruning in tea is necessary for getting a balanced and quality yield of tea. It was cleared that pruning types had significant effect on quality and yield of tea. From Figure 01, it was observed that Treatment T2 (LP), T3 (DSK) and T4 (MSK) had negative yield trend while T5 (LSK) and T6 (LoS) had positive yield trend than control (T1). Yield was increased gradually in T5 and T6 treatment than control T1. It was found that, T2 (LP) gave 31.7% less yield while T6 (LoS) gave 10.8% higher yield than T1 (Unprune).
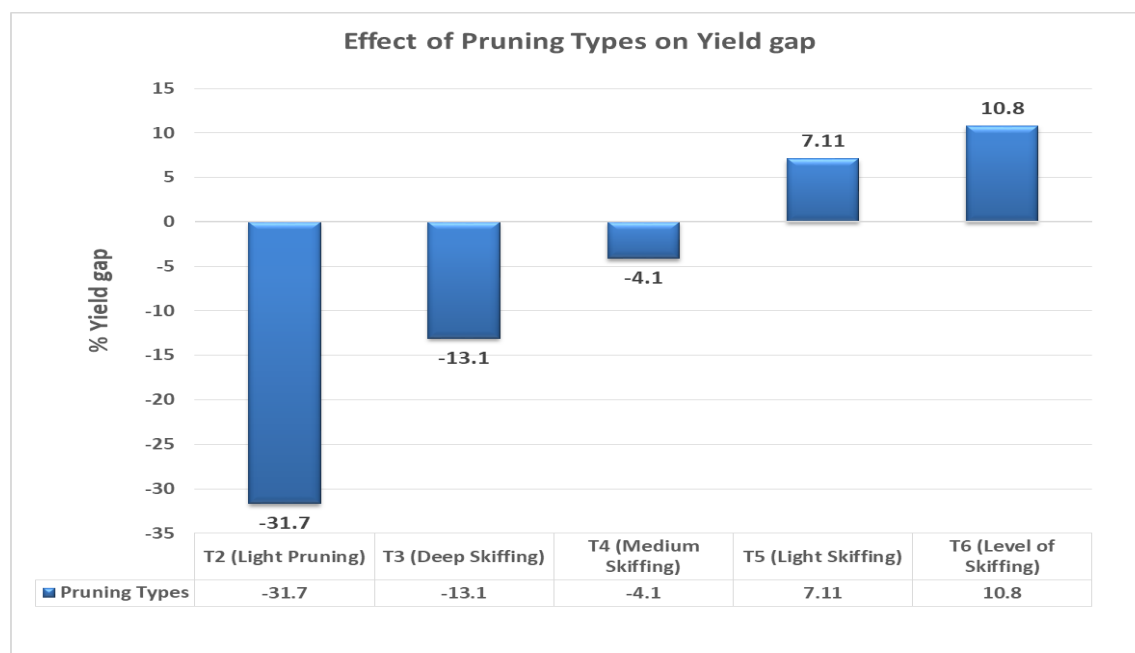
Figure 1. Yield gap (%) in different types of pruning compared to control (Unprune)

3.6 Effect of Pruning Types on Tea Quality

From the analysis result of Organoleptic Quality Scoring, it was observed that significantly highest quality tea was obtained from T2 (Light Pruning) treatment while lowest quality tea was found from T1 (Unpruned) and T6 (Level of Skiffing) treatment (Table 05). Soft, succulent, fresh and tender leaves produce better quality tea. Leaves of LP were more soft and succulent than others. For this reason, highest quality tea was obtained from T2 (Light Pruning) treatment.

Table 05. Yield of tea under different types of pruning

Treatments	Organoleptic Quality Scoring (out of 50)
T1 (Unpruned)- Control	32.31 e
T2 (Light Pruning)	32.93 a
T3 (Deep Skiffing)	32.76 b
T4 (Medium Skiffing)	32.62 c
T5 (Light Skiffing)	32.45 d
T6 (Level of Skiffing)	32.38 e
LSD at 5% level of significance	14.64

The mean difference is significant at P<0.05. Letters indicate values within the same column that are either significantly different (when the letters are different) or not (when the letters are the same) using DMRT at P < 0.05

4. CONCLUSION

Pruning types had significant effect on different growth characters as well as yield and organoleptic quality of Tea. It was found that, number of plucking points/pluckable shoot and yield were found high in T6 (Level of Skiffing), T5 (Light Skiffing) and T1 (Unpruned) than the other treatments. But in terms of tea quality, lowest quality tea was found in T1 (Unpruned), T6 (Level of Skiffing) and T5 (Light Skiffing) treatment. So, it can be concluded that, 'Skiff Pruning' or 'Unprune' technique had positive effect on yield

but the quality of these technique were poor in compare to the other treatments. T2 (Light Pruning) treatment gave more soft, succulent, tender and fresh shoot than the other treatment. For this reason, dry matter was low in T2 (Light Pruning) treatment but tea quality was much better than the other pruning technique.

Based on the results of the experiment, the following conclusion can be drawn:
i.   Pruning has positive or negative effect on yield and quality of tea.
ii.   'Skiff Pruning' or 'Unprune' has positive effect on yield but the quality of is poor than the other treatments.
iii. Best Quality tea can be produced from Light Pruning tea section because of having more tender and fresh shoot than the other treatment.

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