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# ENHANCING QUALITY AND YIELD OF CHERRY TOMATOES IN HYDROPONIC SYSTEMS THROUGH STEM PRUNING

**M. A. Samad[1*], M. I. Hossain[2], M. J. Rahman[2], M. M. Rashid[3] and M. R. Aktar[4]**
[1]MS student, [2]Professor, Department of Horticulture
Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh
[3]Bangladesh Sugarcrop Research Institute, Regional Station, Thakurgaon, Bangladesh
[4]MS student, Department of Soil Science, Hajee Mohammad Danesh Science and Technology University, Dinajpur, Bangladesh
*Corresponding author's email: samadsau73@gmail.com

## ABSTRACT

A field experiment was conducted in the semi-greenhouse at the Horticulture Farm of Sher-e-Bangla Agricultural University, Dhaka 1207, Bangladesh, during October 2019 to March 2020 to improve yield and quality of cherry tomato cultivation through stem pruning in hydroponic culture. The experiment consisted of three level of pruning viz. $P_0$= No pruning; $P_1$ = One time stem pruning and $P_2$ = Two times stem pruning and four different cherry tomato varieties viz. $V_1$= BARI Tomato-11; $V_2$= BARI Tomato-20; $V_3$= Red Star $F_1$ and $V_4$ = SAU Tomato-2. There were 12 treatment combinations and experiment were setup in two factors Completely Randomized Design (CRD) with three replications. For pruning, maximum fruit number per plant (263.33), fruit length (2.45 cm), fruit diameter (2.45 cm), highest single fruit weight (9.31 g), yield plant$^{-1}$ (2.37 kg) and TSS (9.46 degrees Brix) were obtained from $P_2$ treatment at 60 DAT. Similarly, in case of varieties, maximum fruit number per plant (257.82), fruit length (2.44 cm), diameter (2.01 cm), highest single fruit weight (8.50 g), yield per plant (2.63 kg) and TSS (8.92 degrees Brix) were obtained from $V_2$ treatment at 60 DAT. In combined effect, maximum fruit number per plant (302.77), fruit length (2.60 cm), diameter (2.20 cm), highest single fruit weight (12.42 g), yield per plant (2.98 kg) and TSS (10.53 degrees Brix) were obtained from $V_2P_2$ treatment. Among the treatment combination, $V_2P_2$ (BARI Tomato-20 variety with two times stem pruning) treatment seemed to be more promising for obtaining higher yield of cherry tomato. Among the treatment combination, $V_2P_2$ (BARI Tomato-20 variety with two times stem pruning) treatment seemed to be more promising for obtaining higher yield and quality of cherry tomato.

**Key words:** Cherry tomato, pruning, yield, quality, hydroponic

## Introduction

In Bangladesh, cherry tomato is new type for tomato production and still infancy for farmer field and as well as for consumer market (Uddin *et al.,* 2015). In general, with ever increasing demand, it has become imperative to develop high yielding varieties with resistance to biotic and abiotic stresses and adoption of proper cultural practices. The growing demand for increased productivity and quality of agricultural products is a catalyst for agricultural development, thus, there is a constant need to adapt products and the means of production. This aspect is particularly relevant to horticulture because most producers have a small growing area in which they seek to obtain the maximum possible income (Rinaldi *et al.,* 2008). Soilless crops allow production in a small area and can maintain product quality at satisfactory levels, as well as serving as a strategy for soil conservation and preservation of water sources (Oliveira *et al.,* 2016). Pruning is the selective removal of side shoots or stem to limit plant growth and to divert nutrients to flower clusters on the remaining shoot or stem. Fruit pruning is used to limit the number of fruit per truss/cluster and reduce the competition to increase fruit mass (Fanasca *et al*., 2007). A large reduction in tomato yield was reported when side shoots were allowed to develop to 21 days, compared to 7 days (Navarrete and Jeannequin, 2000). Yield, quality and fruit size of tomatoes is influenced by many factors, including plant population (Ara *et al*., 2007), fruit pruning (Ghebremariam, 2005), as well as stem pruning and cultivar selection (Maboko and Du Plooy, 2008). Pruning in tomatoes has been reported to increase yields and quality of fruits (Srinivasan *et al.,* 2001). Bennewitz *et al.* (2011) reported that yield of pruned

tomato plants was significantly lower than unpruned plants, in a determinate variety, but significantly higher in indeterminate and semi-indeterminate varieties. So, the requirements of stem pruning are variable for different variety and growing conditions. Moreover, in Bangladesh, majority of the grower's don not get higher growth of tomato because of their very little knowledge about suitable varieties and proper pruning practices. Considering the above facts, the experiment has been undertaken to find out the suitable combination of different varieties and level of pruning for ensuring the maximum yield and quality of cherry tomato.

## Materials and Methods

A field experiment was conducted in the semi-greenhouse at the Horticulture Farm of Sher-e- Bangla Agricultural University, Dhaka 1207, Bangladesh, during October 2019 to March 2020 to improve yield and quality of cherry tomato cultivation through stem pruning in hydroponic culture. The experiment consisted of three level of pruning viz. P0= No pruning; P1 = One time stem pruning and P2 = Two times stem pruning and four different cherry tomato varieties viz. V1= BARI Tomato-11; V2= BARI Tomato-20; V3= Red Star F1 and V4 = SAU Tomato-2. There were 12 treatment combinations and experiment were setup in Completely Randomized Design (CRD) with three replications.

**Experimental environment:** Round eight-inch 36 plastic pots were prepared for culturing the plants. Polythene sheet was placed in the surface of the soil. Pots were filled with different substrates of coco peat, brick broken and rice husk at the ratio of 6:2:2 (v/v). Two-week-old seedlings were transferred in to the 250mL plastic pots. The experiment was conducted in a white net house under intensive care. The room was kept clean and tidy during the time of the experiment. Daily supervise on was maintained to protect plants. The plants were cultivating and it continued until March 2020.

**Growing media preparation for seedling raising:** The mixture of coco peat, broken bricks (khoa) and rice husk at the ratio of 50:30:20 (v/v). Coconut block was soaked in a big bowl for 24hours.Then they are mixed with khoa and rice husk properly. This mixture was placed in a styro foam sheet box for using seedbed (Fig. 1).

**Seed sowing:** The seeds were soaked in water for 24 hours and then wrapped with piece of thin cloth. The socked seed were then spread over polythene sheet for 2 hours to dry out the surface water. After that seeds were sown in styro foam sheet box and covered with newspaper under room temperature for raising seedling.

**Transplanting of cherry tomato seedling:** 15 days old cherry tomato seedlings were transferred to 250 ml earthen pot. After four weeks the seedlings were transplanted to the main12-inch plastic pot. The plants were transplanted carefully so that the roots were not damaged. After transplanting of tomato plant in the earthen pot light watering was done with sprayer so that the plant was got proper moisture.

**Intercultural operations:** Different intercultural operations were done in proper time. Among them staking was done using Dhaincha (*Sesbania* sp.) sticks to keep the plants erect. Within a few days ofs taking, as the plants grew up, the plants were pruned as per the treatments.

**Data collection and analysis:** Data on the growth and yield parameters such as plant height, number of branches per plant, leaf chlorophyll content and tomato yield were recorded from the net experiment. The data obtained from the experiment were analyzed statistically using MSTAT computer package program to find out the significance of the difference among the treatments. The significance of the differences among the pairs of treatment means was estimated by the Duncan Multiple Range Test (DMRT) at 5% level of probability (Gomez and Gomez, 1984) for the interpretation of results.

## Results and Discussion

**Number of fruits per plant:** A significant variation was recorded due to effect of different pruning on number of fruits per plant under the present investigation (Table 1). The maximum number of fruits per

plant (263.33) was recorded in P2 (Double stemmed plants) treatment and the minimum number of fruits per plant (123.52) was recorded from P0 (unpruned plants). Different varieties also showed significant variation on number of fruits per plant under the present investigation (Table 1). The maximum (257.82) number of fruits per plant was recorded from V2 (BARI Tomato-20) treatment and the minimum (146.33) was observed in V1 (BARI Tomato-11) treatment. Parvin (2012) found BARI Tomato 15 variety gave the highest number of fruits per plant (148.05) which was similar to the present study. A significant variation was found due to combined effect of varieties and different pruning on number of fruits per plant in cherry tomato (Table 1). The maximum number of fruits per plant (302.77) was recorded from V2P2 (BARI Tomato-20 variety with two stem pruning) treatment combination, while V1P0 (BARI Tomato-11variety with no pruning) treatment combination gave the minimum number of fruit (62.67) per plant.

**Length of individual fruit:** Pruning practices exhibited wide variation in respect of mean length of individual fruit of cherry tomato (Table 1). The maximum fruit length (2.45 cm) was obtained from double stem plants whereas the minimum (1.93 cm) was obtained from unpruned plants. The results were in agreement with those of Muhammad and Singh (2007). They reported that mean fruit length was significantly higher in two stem pruned plants than un-pruned plants. Different varieties showed significant variation on length of individual fruit. The maximum (2.44cm) length of individual fruit was recorded from V2 (BARI Tomato-20) treatment which was statistically identical with V3 (2.31) and V4(2.22) and the minimum (1.96 cm) was obtained from V1 (BARI Tomato-11) treatment. The variation was found due to interaction effect of varieties and pruning on length of individual fruit under the trial (Table 1). The maximum (2.60 cm) length was recorded from treatment combination V2P2 (BARI Tomato-20 variety with two stem pruning) which was statistically identical with V3P2 (2.63 cm), while the V1P0 (BARI Tomato-11 variety with no pruning) treatment combination had minimum (1.27 cm) length of fruit.

**Fruit diameter:** Pruning practices exhibited wide variation in respect of mean diameter of individual fruit of cherry tomato (Table1). The maximum fruit diameter (2.45 cm) was obtained from double stem plants whereas the minimum (1.93 cm) was obtained from unpruned plants. The results were in agreement with those of Alam *et al.* (2016). They reported that mean fruit diameter was significantly higher in two stem pruned plants than unpruned plants. Different varieties showed significant variation on diameter of individual fruit under the present trial (Table 1). The maximum (2.01cm) diameter of individual fruit was recorded from V2 (BARITomato-20) treatment and the minimum (1.56 cm) was obtained from V1 (BARI Tomato-11) treatment. Interaction effect was varied significantly due to different varieties and pruning for diameter of individual fruit of cherry tomato (Table 1). The maximum (2.20 cm) diameter of individual fruit was recorded from treatment combination of V2P2 (BARI Tomato-20 variety with two stem pruning) treatment combination, which was statistically identical with V4P2 (2.17cm) while the treatment combination V1P0 (BARI Tomato-11 variety with no pruning) treatment combination had minimum (1.10 cm) diameter of individual fruit.

**Weight of individual fruit:** Different levels of pruning showed significant influence on the weight of individual fruit of cherry tomato (Table 1). The maximum weight (9.31 g) of individual fruit was recorded from P2 (Double stemmed plants) treatment which was statistically identical with P1 (8.98g) and the minimum (6.00 g) was recorded from P0 (unpruned plants) treatment. A significant variation was recorded for varieties on weight of individual fruit of cherry tomato under the present trial (Table 1). The weight of individual fruit ranged from 6.53g to 8.50g.The maximum weight (8.50 g) weight of individual fruit was recorded from V2 (BARI Tomato-20) treatment and the minimum (6.53 g) was recorded fromV1 (BARI Tomato-11) treatment. A significant variation was found due to interaction effect of varieties and pruning practices for weight of individual fruit of cherry tomato under the trial (Table 1) .The maximum (12.42g) weight of individual fruit was recorded from treatment combinations of V2P2 (BARI Tomato-20 variety with two stem pruning) treatment combination, while the treatment combination V1P0 (BARI Tomato-11 variety with no pruning) treatment combination had minimum (5.03 g) weight of individual fruit.

Table 1. Single as well as combined effect of pruning and variety on yield attributing characteristics of cherry tomato

| Treatments | No. of fruit per plant | Individual fruit length (cm) | Individual fruit diameter (cm) | Individual fruit weight (g) |
|---|---|---|---|---|
| Effect of pruning | | | | |
| P0 | 123.52 c | 1.93 b | 1.46 b | 6.00 b |
| P1 | 187.00 b | 2.29 a | 1.91 a | 8.98 a |
| P2 | 263.33 a | 2.45 a | 1.96 a | 9.31 a |
| LSD(0.05) | 5.39 | 0.23 | 0.20 | 0.42 |
| Effect of variety | | | | |
| V1 | 146.33 d | 1.92 b | 1.56 c | 6.53 c |
| V2 | 257.82 a | 2.44 a | 2.01 a | 8.50 a |
| V3 | 200.76 b | 2.31 a | 1.86 ab | 7.06 b |
| V4 | 160.27 c | 2.22 a | 1.68 bc | 6.53 c |
| LSD(0.05) | 5.39 | 0.23 | 0.20 | 0.42 |
| Combined effect | | | | |
| V0P0 | 62.67 i | 1.27 d | 1.10 e | 5.03 f |
| V1P1 | 94.00 h | 2.07 c | 1.53 d | 10.17 c |
| V1P2 | 244.73 c | 2.27 bc | 1.67 cd | 7.33 d |
| V2P0 | 92.67 h | 2.13 c | 1.53 d | 6.42 e |
| V2P1 | 242.36 c | 2.27 bc | 1.83 bc | 7.33 d |
| V2P2 | 302.77 a | 2.60 a | 2.20 a | 12.42 a |
| V3P0 | 134.00 g | 2.23 bc | 1.77 c | 5.17 f |
| V3P1 | 234.00 d | 2.30 bc | 2.00 ab | 7.33 d |
| V3P2 | 274.00 b | 2.63 a | 2.03 ab | 7.33 d |
| V4P0 | 154.00 f | 2.23 bc | 1.73 cd | 7.17 d |
| V4P1 | 226.00 e | 2.27 bc | 1.73 cd | 7.42 d |
| V4P2 | 234.00 d | 2.43 ab | 2.17 a | 11.17 b |
| LSD(0.05) | 5.39 | 0.23 | 0.20 | 0.42 |

In a column means having similar letter (s) are statistically identical and those having dissimilar letter (s) differ significantly as per 0.05 level of probability.

**Fruit yield per plant:** Due to pruning yield plant$^{-1}$ showed significant variation (Fig. 1). The highest yield per plant (2.37 kg) was observed in P2 (double stem pruning), which was statistically identical with P1 (2.29kg) and the lowest (1.92kg) was found P0 (unpruned plants). Ece and Darakci (2007) reported that double stem application should be implemented for higher yield in tomato. Yield plant$^{-1}$ varied significantly due to the use of different varieties of cherry tomato (Fig. 2). The maximum yield plant$^{-1}$ (2.63 kg) was recorded from V2 (BARITomato-20) treatment, which was statistically similar with V3 (2.36kg) and the minimum yield per plant (1.64 kg) was obtained from V1 (BARI Tomato-11) treatment.

**Combine effect of varieties and pruning:** The integrated effect had a significant variation in terms of yield of fruit (Table 2). The maximum yield per plant (2.97 kg) was recorded from BARI Tomato-20 variety with two stem pruning treatment combination while the BARI Tomato-11 variety with no pruning) treatment combination gave the minimum (1.27 kg).

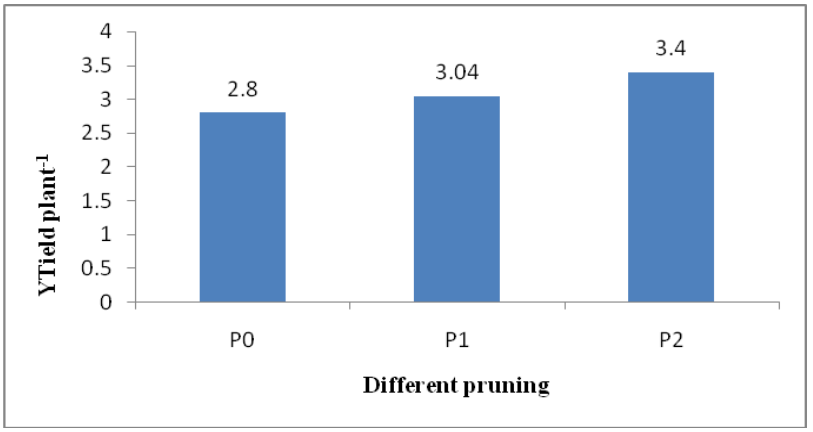


**Fig 1. Effect of pruning on yield plant$^{1}$ (kg) in cherry tomato**

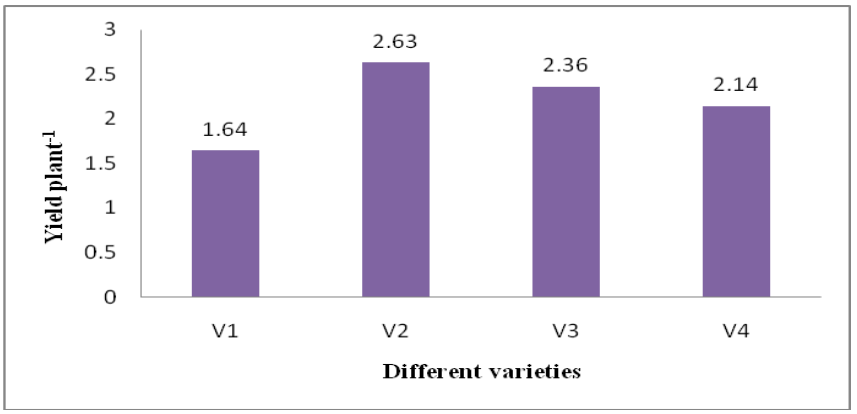


**Fig 2. Effect of different varieties on yield plant$^{-1}$ (kg) in cherry tomato**

Table 2. Combined effect of varieties and pruning on yield plant$^{-1}$ in cherry tomato

| Treatment combination | Yield per plant$^{-1}$ (kg) |
|---|---|
| V1P0 | 1.27 g |
| V1P1 | 1.87 def |
| V1P2 | 2.22 cde |
| V2P0 | 1.64 efg |
| V2P1 | 2.35 bcd |
| V2P2 | 2.98 a |
| V3P0 | 1.43 fg |
| V3P1 | 1.95 def |
| V3P2 | 2.74 abc |
| V4P0 | 2.14 cde |
| V4P1 | 2.83 ab |
| V4P2 | 2.93 ab |
| LSD(0.05) | 0.55 |

**Total soluble solids (Brix) content:** TSS is one of the most important quality factors for most of the fruits and for TSS. The TSS of 8.0 to 17.0% indicates the highest quality of fruits to attain the optimum harvesting stage (Morton, 1987). A significant variation was recorded for pruning on total soluble solids of cherry tomato under the present trial (Table 3). In the study, highest total soluble solids ($9.46^0$B) was recorded from P2 (Double stemmed plants) treatment. Lowest TSS ($7.36^0$B) was recorded from P0 (unpruned plants). A significant variation was recorded for varieties on total soluble solids of cherry tomato under the present trial (Table 3). In the study, highest total soluble solids ($8.92^0$B) was recorded fromV2 (BARITomato-20) treatment, which was statistically identical with V3 (8.81 $^0$B) and V4 (8.56 $^0$B). Lowest TSS (7.47 $^0$B) was recorded from V1 (BARI Tomato-11) treatment. The variation was found due to interaction effect of varieties and pruning for the total soluble solids (TSS) of cherry tomato under the trial (Table 3). The maximum (10.53 $^0$B) total soluble solid was recorded fromV2P2 (BARI Tomato-20 variety with two stem pruning) treatment combination, while the treatment combination V1P0 (BARI Tomato-11 variety with no pruning) treatment combination had minimum (6.37 $^0$B) weight of individual fruit which was statistically identical with V2P0 (6.73 $^0$B).

Table 3. Single and integrated combined effect of pruning and variety on total soluble solids content of fruit

| Treatments | Total soluble solids ($^0$B) |
|---|---|
| Effect of pruning | |
| P0 | **7.36 c** |
| P1 | 8.50 b |
| P2 | 9.46 a |
| LSD(0.05) | 0.96 |
| Effect of variety | |
| V1 | 7.47 b |
| V2 | 8.92 a |
| V3 | 8.81 a |
| V4 | 8.56 a |
| LSD(0.05) | 0.96 |
| Combined effect | |
| V0P0 | 6.37 e |
| V1P1 | 7.77 d |
| V1P2 | 8.57 c |
| V2P0 | 6.73 e |
| V2P1 | 9.50 b |
| V2P2 | 10.53 a |
| V3P0 | 7.67 d |
| V3P1 | 8.37 c |
| V3P2 | 9.43 b |
| V4P0 | 7.33 d |
| V4P1 | 7.67 d |
| V4P2 | 9.50 b |
| LSD(0.05) | 0.50 |

In a column means having similar letter (s) are statistically identical and those having dissimilar letter (s) differ significantly as per 0.05 level of probability.

## Conclusion

The overall result of this experiment showed that yield parameters and quality of cherry tomato were significantly influenced by the different pruning. Among the varieties, BARI Tomato-20 seemed to be more promising according to morphological character for getting higher yield and quality. Considering the levels of pruning, when two stems were pruned the plants performed highest yield and quality. The combined effect of varieties and different pruning had a positive effect on morphological characters, yield contributing characters, yield and quality of cherry tomato. BARI Tomato-20 variety with two stem pruning of cherry tomato seemed to be more suitable for getting higher yield and quality.

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