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Effect of Stem Pruning and Staking on Growth and Yield of Tomato (*Lycopersicon esculentum* L.)

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Abstract—*An experiment was conducted to study the effect of stem pruning and staking on growth and yield of tomato at Institute of Biological Science research field, Rajshahi University during the period from November, 2015 to February, 2016. There were eight treatment combinations which comprised two levels of staking viz., S_0= without staking and S_1= with staking and four levels of stem pruning P_0= no pruning, P_1= one stem keeping all pruning, P_2= two stem keeping all pruning and P_3= three stem keeping all pruning. Plant with staking gave the higher marketable yield (73.13 t/ha) and without staking gave the lowest marketable yield (61.86 t/ha) and number of fruits/plant. Two stem keeping all pruning yielded the highest marketable yield (73.93 t/ha) and one stem keeping all pruning gave the lowest (60.00 t/ha) and number of fruits/plant. With staking coupled with two stem keeping showed superior interaction (78.69 t/ha) to others.*

Keyword*: Stem pruning, Staking, Yield, Tomato*

1. INTRODUCTION

Tomato (*Lycopersicon esculentum* L.) belongs to the family Solanance is one of the most important vegetables worldwide. It is a good source of vitamins (A and C) and minerals.[1-2] It is also the dependable source of vitamin A, B, C and D, minerals, Ca, P and Fe.[3] It contains higher quantity of total sugar (2.5-4.5%), starch (0.6- 1.2 %) as well as antioxidant elements such as lycopen which prevents cancer.[4] Tomato is used as for salad as well as processed products like tomato sauce, pickle, ketchup, puree, dehydrated and whole peeled tomatoes. It is equally preferred from the richest to the poorest people of our county due to its good tastes and easy availability. Although the total cultivated area and production of tomato in our country have increased gradually over the last few years but the productivity is still very low (6.46 t/ha) compared to the average yield (26.29t/ha) of the world as per.[5] In Bangladesh it is cultivated as winter vegetable, which occupies on area of 188000 acres of land with annual production of about 167000 metric tons.[6]

Tomato is one of the most important crops widely grown, but yield variation was observed in different agroecological zones. Yield as a complex character depends on many quantitative components and is influenced by environmental factors. Yield also expression of a genotype is mainly governed by environment and other management factors. Yield variation may be occurred due to variation in cultural practices. Stem pruning and staking are the most important factors. Staking improves fruit quality by keeping plants and fruits off the ground thus reduces rotting, incidence of soil borne diseases and providing a better spray coverage, pruning diverts nutrients to flower clusters and fruits on the main stem and allows more efficient air circulation. Therefore, the present study was undertaken to investigate the effect of appropriate stem pruning and staking (Intercultural management) practices for higher yield and better quality of tomato.

2. MATERIALS AND METHODS

The field experiment was conducted during the period from October to March of 2015- 2016 at research field of Institute of Biological Science, Rajshahi University. The experimental plot was laid out in Randomized Complete Block Design (RCBD) with three replications. The tomato variety ACI super was used as a test material. The soil of the experimental area was sandy loam belonging to the low Ganges river floodplain under the agro ecological zone-11. The selected site was a well-drained medium high land having soil pH 7.8. In this trials, two types of staking were S_0= without staking, S_1= with staking and four types of prunings were P_1= one stem keeping all pruning, P_2= two stem keeping all pruning, P_3= three stem keeping all pruning and P_0 = no pruning. The seeds were sown in seed bed on October 21, 2015 and transplanted in the main field on November 20, 2015. Manures and fertilizer were applied at the rate of 8 ton cowdung, 500kg Urea, 400kg TSP and 200kg MP per hectare.[7] Half of the quantity of cowdung, were applied during final land preparation. The remaining half of cowdung, the entire quantity of TSP, one third each of Urea and MP were applied during pit preparation. The rest of Urea and MP were applied in two equal installments at 21 and 35 days after transplanting. The plants were staked with Bamboo sticks at 21 days after transplanting to prevent lodging as per treatment. Pruning was done by secateur to remove the unwanted auxiliary buds and branches depending on the treatments. Insecticide such as carbosulfar were sprayed @ 1.5

ml/l of water at seven days interval to control fruit worm and rovral 50 WP (Iprodine) was sprayed @ 2g/l of water to control leaf spot disease. Irrigation and other intercultural operation were done as and when necessary. Observation was made from 5 randomly selected plants per plot. Data were recorded on number of flowers per plant, number of fruits per plant, days to maturity, weight of single fruit (g) and yield t/ha. The significance of the difference between treatment means was evaluated by the least significance difference (LSD) test for the interpretation of the results.[8]

3. RESULTS AND DISCUSSION

Number of flowers per plant

The main effect of staking and different levels of stem pruning in relation to the number of flowers per plant was significant (Table 1). The highest number of flowers per plant (37.62) was found with staking and the lowest number of flowers per plant (35.98) was obtained from without staking. The highest number of flowers per plant (48.10) was found in no stem pruning and the lowest number of flowers per plant (25.17) was obtained from one stem remaining all pruning plants. The combined effect of staking and stem pruning on the number of flowers per plant was found to be statistically significant at 1% level of probability (Table 2). The highest number of flowers per plant (50.40) was found in the treatment combination of P_0K_1 (no stem pruning and without staking). On the other hand, the lowest number of flowers per plant (24.67) was obtained from the treatment combination of P_1K_0 (one stem keeping and without staking plants). Sowley reported that the number of flowers was affected by pruning and staking. Unstaked-unpruned promoted higher number of flowers per plant and staked-pruned recorded the lower number of flowers.[9] Probably the above variation was exhibited because higher branching and very lower branching reduces the number of flowers per cluster as well as number of flowers per plant.

Number of fruits per plant

The main effect of staking in relation to the number of fruits per plant was significant (Table 1). The highest number of fruits per plant (19.73) was obtained from with staking and the lowest number of fruits per plant (18.72) was obtained from without staking. The highest number of fruits per plant (23.03) was found from no stem pruning and the lowest number of fruits per plant (15.03) was obtained from one stem keeping all pruning plants. The combined effect of staking and stem pruning on the number of fruits per plant was found to be statistically significant at 1% level of probability (Table 2). The highest number of fruits per plant (23.20) was found from the treatment combination of P_0K_1 (no stem pruning and without staking) followed by P_0K_0 (no stem pruning and without staking) (22.87). On the other hand, the lowest number of fruits per plant (13.93) was obtained from the treatment combination of P_1K_0 (one stem keeping all pruning and without staking plants). It was found that two stem keeping all pruning plant gave the highest number of marketable fruits per plant and one stem remained plants gave the lowest.[10] Lim and Chen found similar findings.[11] Ogundare observed that staking significantly affect on number of fruits per plant.[12] Sowley showed that the number of fruits was affected by pruning and staking.[9]

Days to maturity

A significant variation in days to maturity of fruits was observed due to the main effect of staking (Table 1). The maximum days to maturity of fruit (85.13) were found by with staking and the minimum days to maturity of fruit (83.60) was obtained by without staking plant. The variation in days to maturity of fruits at different pruning levels was significant. The maximum days to maturity of fruit (89.77) were found from no stem pruning and the minimum days to maturity of fruit (80.63) was found from one stem keeping all pruning. The combined effect of staking and stem pruning in respect of days to maturity of fruits was found to be statistically significant at 1% level of probability (Table 2). The maximum days to maturity of fruits (90.27) was obtained from treatment combination P_0K_0 (no stem pruning and without staking) plants, whereas the minimum days to maturity of fruits (79.27) was produced from treatment combination P_1K_1 (one stem keeping all pruning and with staking) plants. This could be due to better photosynthetic activity created by good arrangement of fruits and lead to maturity.

Weight of single fruit(g)

Weight of single fruit is one of the most important qualitative characte. Different levels of staking exhibited significant variation in respect of average weight of single fruits (Table 1). Maximum single fruit weight (91.13 g) was found with staking plant, while the minimum fruit weight (82.48 g) was found without staking plant. The variation in weight of single fruit at different pruning levels was also significant. Maximum weight of individual fruit (105.17 g) was obtained from one stem remained plants whereas the minimum (62.40 g) produced from no stem pruned plants. Significantly variation was found on weight of single fruits by staking and it is showed that the maximum weight of single fruits was obtained from with staking and the minimum weight of single fruits was obtained from no staking plants.[12] Similar result is found by Quinn.[13] Significant difference in weight of individual fruit due to the combined effect of staking and stem pruning was observed at 1% level of probability (Table 2). The maximum weight of individual fruit per plant (108.40 g) was obtained from the treatment combination of P_1K_1 (one stem keeping all pruning and with staking) and the lowest number (69.13 g) was obtained from no stem pruning and with staking. Single fruit weight was significantly higher obtained from one stem keeping all pruning and lower from unpruned plant. This finding was almost in agreement with the reported by Uddin.[14]

Fruit yield ton per hectare

Significant variation was found in respect of different levels of staking for fruit yield ton per hectare (Table 1). The result showed that the highest yield of tomato fruits (73.13 t/ha) was obtained from with staking plants, and the lowest yield of tomato fruits (61.86 t/ha) was obtained from the plant without staking. Difference level of stem pruning significantly influenced on the yield of fruits per hectare. The highest yield (73.93 t/ha) was recorded through the practice of two stem keeping all pruning compared to three stem keeping all pruned plants (69.98 t/ha) and the lowest yield of tomato fruits (60.00 t/ha) was obtained from the plant one stem keeping all pruning. Similar results were found by many authors (Baki, 1987 and Homme, 1965). The combined effect of staking and stem pruning on fruit yield per hectare was significant at 5% level of probability (Table 2). The highest fruit yield (78.69 t/ha) was obtained from the treatment combination of two stem keeping all pruning and with staking (Fig. 1). On the other hand, the lowest fruits yield (53.21t/ha) was obtained from the treatment combination of P_0K_0 (no stem pruning and without staking plants). Ara found that significantly highest yield was obtained from two stem pruning.[10] Unpruned gave the lowest yield (58.65t/ha). Lim and Chen, Uddin found similar results.[11,14] Sowley showed that staking prevented rotting of fruits and pruning increased fruit size there by increasing marketable yield of tomatoes.[9] Staking increases fruits yield, reduce the proportion of unmarketable fruit and facilitates chemical spraying and harvesting.[15] Staking produce high quality fruits and avoids fruits rot. It allows better aeration, reduces attack of fungus disease and ensures better exposure of the foliage to light for better photosynthesis.[16]

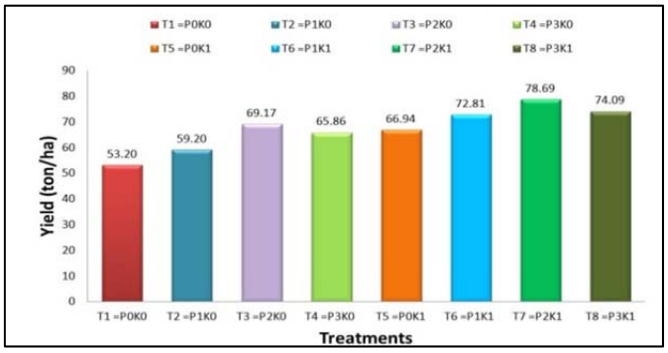

Fig. 1: Effect of stem pruning & staking on the yield (ton/ha) of tomato

Table 1: Single effect of stem pruning and staking on yield contributing characteristics of tomato

Treatments	No. of flowers per plant	No. of fruits per plant	Days to maturity	Wt. of single fruit (g)	Yield (t/ha)
Staking					
K_0	35.98	18.72	85.13	82.48	61.86
K_1	37.62	19.73	83.60	91.13	73.13
Level of significance	**	**	**	**	**
LSD 1%	1.33	0.85	0.70	1.81	2.40
Stem Pruning					
P_0	48.10	23.03	89.77	62.40	60.08
P_1	25.17	15.03	80.63	105.17	60.00
P_2	35.60	17.53	82.43	100.87	73.93
P_3	38.33	21.30	84.63	78.80	69.98
Level of significance	**	**	**	**	**
LSD at 1%	1.33	0.85	0.70	1.81	2.40

**=Significant at 1% level of probability; Whereas, K_0= Without staking; K_1= With staking.
P_0= No pruning; P_1= One stem keeping all pruning; P_2= Two stem keeping all pruning; P_3= Three stem keeping all pruning

Table 2: Combined effect of stem pruning and staking on yield of contributing characters of tomato

Treatments	No. of flowers per plant	No. of fruits per plant	Days to maturity	Wt. of single fruit (g)	Yield (t/ha)
$T_1 = P_0K_0$	45.80	22.87	90.27	55.67	53.21
$T_2 = P_1K_0$	24.67	13.93	82.00	101.93	59.20
$T_3 = P_2K_0$	36.00	17.00	83.27	97.33	69.17
$T_4 = P_3K_0$	37.47	21.07	85.00	75.00	65.86
$T_5 = P_0K_1$	50.40	23.20	89.27	69.13	66.95
$T_6 = P_1K_1$	25.67	16.13	79.27	108.40	72.80
$T_7 = P_2K_1$	35.20	18.07	81.60	104.40	78.69
$T_8 = P_3K_1$	39.20	21.53	84.27	82.60	74.09
Level of significance	**	**	**	**	*
LSD at 5%	-	-	-	-	2.50
LSD at 1%	1.87	0.85	0.99	2.56	

*=Significant at 5% level of probability;
**=Significant at 1% level of probability; Whereas, K_0= Without staking; K_1= With staking.
P_0= No pruning; P_1= One stem keeping all pruning; P_2= Two stem keeping all pruning; P_3= Three stem keeping all pruning

4. CONCLUSION

From the above discussion, it could be concluded that stem pruning and staking is beneficial to produce higher yield of tomato. Stem pruning remaining two stems and staking plant may be recommended for farmers' to produce higher yield of tomato var. ACI super. To finalize the results and fully recommendation to the farmers', the experiment may be repeated using other released varieties and different locations in Bangladesh.

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