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Efficiency of Mulching and Staking on Tomato (*Solanum lycopersicum*) Yield

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Abstract

The present study was conducted to determine the efficiency of mulching and staking on yield of tomato. The experiment was carried out at Agricultural Research Field, Noakahali Science and Technology University, Noakhali, Bangladesh during the period from September 2018 to March 2019. The single factor experiment was laid out Randomized Complete Block Design (RCBD) with three replication. Four treatments viz., T_0= Control, T_1= Mulching T_2= Staking and T_3=Mulching and Staking were selected. Data were recorded on plant height, number of leaves/plant, number of branch/plant, number of flowers/plant, number of fruits/plant, individual fruit weight (g), weight of fruits/plant (kg) and yield kg/plot. All the parameters were statistically differed among the treatments. Highest plant height (129.87 cm), number of leaves/plant (64.67), number of branch/plant (6.07), number of flowers/plant (53.37), number of fruits/plant (45.33), individual fruit weight (93.33g), weight of fruits/plant (4.16 kg) and yield/plot (49.03kg) were recorded from T_3 (Mulching and staking)in compared with T_2 (Staking) whereas lowest data on plant height(74.53 cm), number of leaves/plant (40.80)number of branch/plant (2.38), number of flowers/plant (30.47), number of fruits/plant(21.82), individual fruit weight (73.43g), weight of fruits/plant (1.65kg) and yield kg/plot (20.06kg) were notified from control. Considering the results it can be concluded that using of mulching along with staking gave the better yield contributing characters of tomato in contemporary with others treatments.

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Introduction

Tomato (*Solanum lycopersicum*) is a well-produced, most popular and self-crossing winter season vegetable in Bangladesh and all over the world. Tomato is one of the important Solanaceous vegetable crops grown in throughout of the world having the chromosome number 2n = 24. The genus *solanum* include nine species out of which only two are cultivated, *Solanum lycopersicum* (common tomato) and *Solanum pimpinellifolium* Mill (currant tomato) (Rashid, 1999).

Bangladesh is an agro-based country where agriculture is considered as backbone of her economy. About 80 percent of its population lives in rural areas and 62 percent of total labor force are engaged in agriculture (BBS, 2005). Agriculture plays a vital role through employment generation, poverty alleviation, food security, enhance standard of living by increasing income level of rural population. Vegetables production can help farmers to generate which eventually alleviate poverty.

Among the vegetables tomato is one of the most important vegetables in terms of acreage, production, yield, commercial use and consumption. It ranks next to potato and sweet potato in world vegetables production (Rashid *et al.,* 1981) and tops the list of canned vegetables (Chaudhary, 1979).

Generally, the tomato is grown in Bangladesh during the months from September to April, when rainfall is minimum, and about 250 mm to soil moisture is exhausted by evaporation. Water is the single factor which directly influences the yield of tomato, because it contains 94% water. Successful tomato cultivation largely depends on the optimum cultural management practices.

This includes judicious application of manures and fertilizers, efficient use of available soil moisture, spacing, time of planting and weed control etc. Out of these efficient uses of soil moisture and staking is very important. Irrigation facilities are not sufficient in all the regions of the country. Sometimes pumps cannot lift water in dry season due to low water table. Moreover, many of the farmers cannot afford the expense of irrigation. Indigenous mulches like plastic mulch, straw, rice husk, water hyacinth, crop residues are generally practiced in the production of horticultural crops. Different types of mulch play an important role in conserving soil moisture (Sub and Kim, 1991) as well as staking is a means of providing supports to ensure clean and unblemished fruits which kept fruits off from the ground, minimizing diseases and rotting of fruits thereby increasing marketable yield (Hanna and Adams, 1982).

Research continues on the use of mulching and staking on tomato, thereby affecting plant growth and development. Therefore, the present study was conducted to determine the effect of mulching and staking on growth and yield of tomato.

Materials and methods

Location and soil

The present research was conducted at Agricultural research field, Noakhali Science and Tachnology University Noakhali, Bangladesh during the period from September 2018 to March 2019 under the AEZ 18 i.e. Young Meghna Estuarine Floodplain. This region occupies young alluvial land adjoining the Meghna estuary.

The soil of the experimental plots was sandy loam in texture with PH 6.5. The climate of this area was characterized by very little precipitation during November to February.

Treatments of Experiment

The single factor experiment was carried out Randomized Complete Block Design with three replications. Four treatments viz., T_0= Control, T_1= Mulching T_2= Staking and T_3=Mulching and Staking were used for the experiment.

Planting material

BARI Tomato 6 variety were used for this experiment. Seed was collected from local market of Maijdee, Noakhali, Bangladesh.

Seed sowing

Seed sowing was done on 25th September 2018 in the seedbed. Before seed sowing, seed treatment with Carbandazim 50 WP.

Land preparation

The land was ploughed to fine tilth properly. Complete germination of the seed look took place within 3 to 5 days of sowing. Necessary shading by plastic polythene was provided over the seedbed to protect the young seedlings from direct sunlight or heavy rainfall. Seedlings were uprooted carefully from the seed bed.

Plot number and size

Total number of plot 12. The unit plot size was 3.24 meter square. The distance between the blocks was 1 m and that between plots was 50 cm.

Seedlings transplanting

30 days old healthy seedlings are transplanted on 2nd November maintaining spacing 45 cm × 60 cm (plant to plant and row to row) at the rate of one seedlings per hill. 12 plants are planting in the each plot. Immediately after transplanting, light watering to the individual seedlings was provided to overcome water deficit. After establishment of the seedlings, watering was done as and when necessary.

Fertilization

Ten tones of cow dung, 250 kg of urea, 150 kg of TSP and 250 kg of MP per hectare were applied in the experimental plot. Entire amount of cow dung and TSP and half of MP was applied during final land preparation. The entire urea and rest of MP were applied in three equal installments at 15, 30 and 50 days after transplanting in the field.

Application of mulch

Plastic mulching (white color) were applied immediately after transplanting the seedling in the main field.

Staking

Bamboo sticks were used to provide supporting to the plant with the advancement of growth. The sticks were laid loosely with the plants to keep them erect and to protect from damage caused by any kind of adverse situation.

Intercultural operation

Watering was done as and when necessary. Weeding were done to keep the plots free from weeds, easy aeration of soil which ultimately ensured better growth and development. Continuous observation was done to ensure better growth of plants for good yield. Insect attack was not severe. Diseases infestation was not too severe to cause damage to the crop.

Data collection

The data were collected on plant height (cm), number of leaves/plant, number of branches/plant, number of flowers/plant, number of fruits/plant, individual fruit weight (g), weight of fruits/plant (kg) and yield kg/plot from the 6 plants from each plot except yield/plot in different stages of crop growth for obtaining various growth and yield parameters were discussed.

Statistical analysis

The recorded data of different parameters in this studywere analyzed web based agricultural statistics software package (WASP) and Microsoft office Excel 2013 to find out the significant or non-significant within treatments and means were compared at 5% probability level (Gomez and Gomez, 1984).

Results and discussion

Plant height (cm)

Statistically significant variation was found among the treatments in terms of plant height at final harvest (Figure 1). Highest plant height (129.87cm) were recorded from T_3 (Mulching along with staking) in compared with T_2 (only Staking; 120.89cm) whereas lowest data (74.53 cm) were recorded from control (T_0; without staking and mulching). Similar results were noticed from (4, 18). Kelley, (2017) suggested that plastic mulch promotes earliness by capturing heat, which increases soil temperatures and

accelerates growth. It might be due to proper supporting during vegetative stages as well as sufficient moisture retaining into the soil. Plant height is one of the important characters, which is positively correlated with yield of tomato.

Number of leaves/plant

A good number of leaves indicate better growth and development of a crop. It is also positively related to the yield of tomato. The greater number of leaves, the greater the photosynthetic area which may result higher fruit yield. Number of leaves/plant was differed significantly among the treatments (Figure 2). Maximum number of leaves (64.67) was found from T_3 (Mulching with staked plants) followed by T_2 (59.57; Staked plants) and minimum number of leaves (40.8) were recorded from control (T_0; without mulching and staking). Kayum *et al.,* (2008) reported that BARI Tomato-6 gave average 52.50 leaves/plant which are similar to the results.

Table 1. Effects of mulching and staking on yield contributing characters of tomato.

Treatments	Number of flowers/plant	Number of fruits/plant	Individual fruit weight (g)	Weight of fruits/plant(kg)	Yield kg/plot
T_0	30.47c	21.82d	73.43c	1.65d	20.06d
T_1	40.83b	32.60c	77.73c	2.60c	29.66c
T_2	50.11a	40.59b	87.47b	3.54b	42.79b
T_3	53.37a	45.33a	93.33a	4.16a	49.03a
CV (%)	4.05	6.59	3.40	6.17	5.19
CD (5%)	3.53	4.62	5.63	0.36	3.67
CD (1%)	5.36	7.00	8.53	0.55	5.56
Level of significance	**	**	**	**	**

T_0= Control (Without mulching and staking), T_1= Mulching, T_2= Staking, T_3= Mulching and Staking, CV=coefficient of variation, CD= critical differences, Similar letters are not differed at 5% probability and dissimilar letters are differed at 5% probability level.

Number of branches/plant

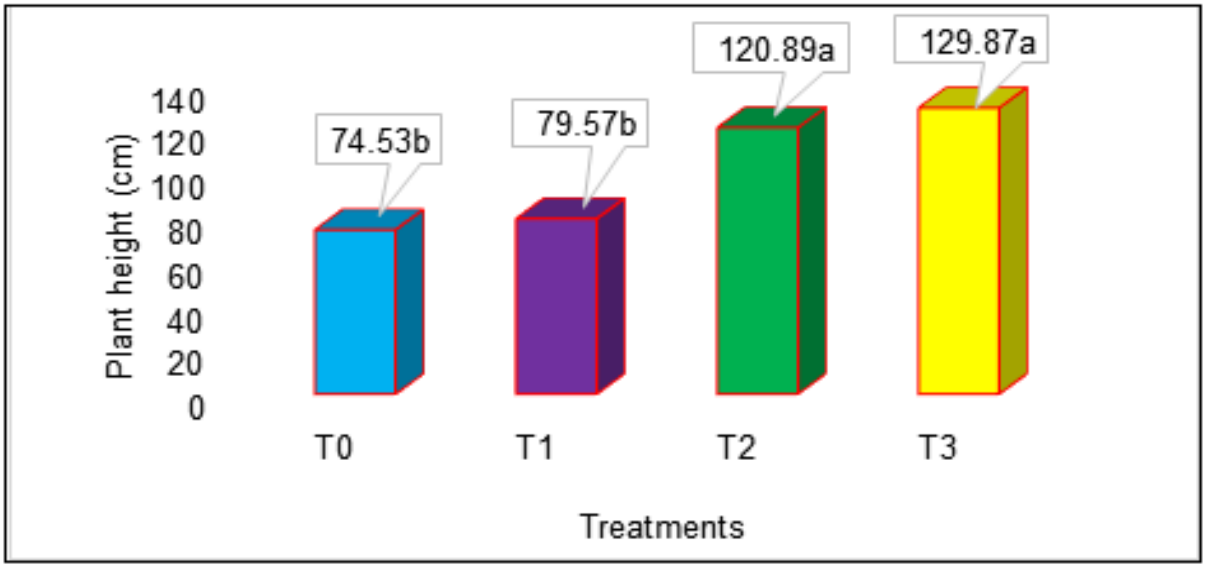
Number of branch per plant was significantly influenced by among the treatments (Figure 3). Maximum number of branch (6.07) were recorded from mulching in staked plants (T_3) in compared with staked plants (5.77; T2). Minimum number of branch (2.83) was found from control (T_0; without mulching and staking). Sowley and Damba, (2013) reported that number of branches as affected by staking.

Number of flowers/plant

A significant effect of mulching and staking was observed on the production of flower per plant (Table 1). Plastic mulch with staking treated plants produced the average highest (53.37) flower followed by only staked plants (50.11).While average the lowest flower (30.47) was found in control. It is apparent from the result that plastic mulch with staking has increased the production of flower per plant. This may be attributed to the enhanced vegetative growth as observed in the treatment. Wien *et al.,* (1993) reported that mulching increased number of flower cluster on main branches and secondary branches compared with no mulch.

Number of fruits/plant

Statistically significant variation was found due to the effects of treatments on the number of fruits production per plant (Table 1). The average maximum number of fruits per plant (45.33) was obtained from plastic mulch with staking treated plants followed by only staked plants (40.59) and the average minimum (21.82) was given in control and only mulched plants gave (32.60) fruits/plant. Kelly, (2017) reported that plastic mulch keeps fruit cleaner by reducing soil spatter of tomato. (2, 5) recommended staking of crops for higher yield of quality fruits. Staking increases fruit yield, reduces the proportion of unmarketable fruit, enhances the production of high quality fruits (Anonymous, 2017).



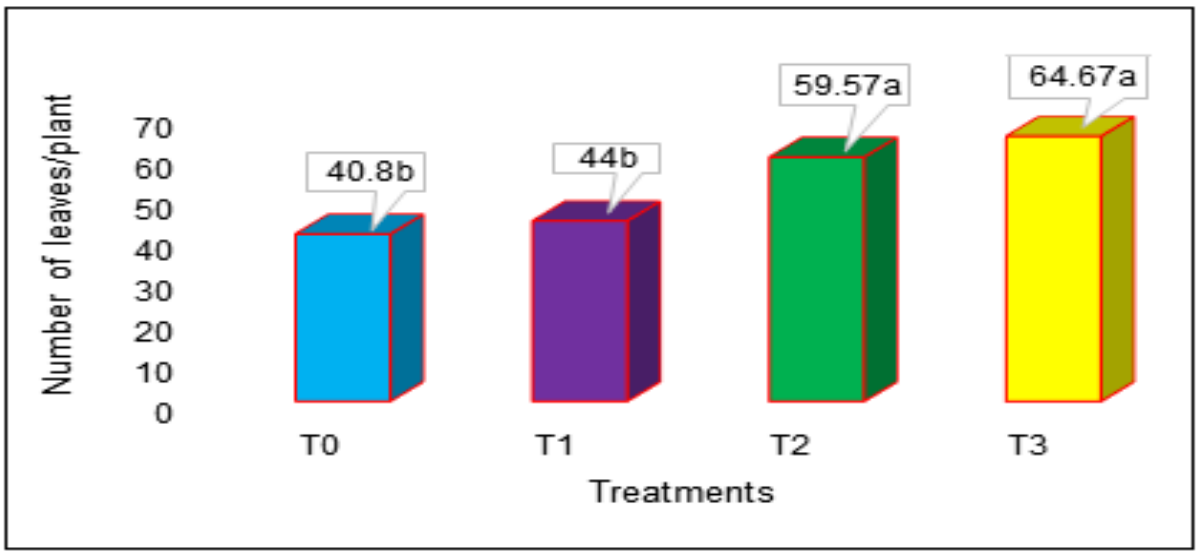
T_0= Control (Without mulching and staking), T_1= Mulching, T_2= Staking, T_3= Mulching and Staking, Similar letters are not differed at 5% probability and dissimilar letters are differed at 5% probability level.

Fig. 1. Effects of Mulching and Staking on plant height of Tomato.

Individual fruit weight (g)

The weight of individual fruit was significant by different treatment (Table 1). The average maximum individual fruit weight (93.33g) was found with the plants grown under plastic mulch with staking treated plants (T_3) in compared with only staking (T_2;87.47g) and the average minimum individual fruit weight (73.43g) was given in control (T_0; without mulching and staking). It could be concluded that mulching along with staking gave the higher individual fruit weight in compared with others treatments. Photosynthetic activities may be enhanced due to better exposure of the foliage to sunlight as a result, fruits accumulate higher assimilates which might be responsible for higher fruit weight in the plants staked with string staking (Alam *et al.,* 2016).

Tipu *et al.,* (2014) noticed that individual fruit weight of tomato significantly increased in mulches over without mulch.



T_0= Control (Without mulching and staking), T_1= Mulching, T_2= Staking, T_3= Mulching and Staking, Similar letters are not differed at 5% probability and dissimilar letters are differed at 5% probability level.

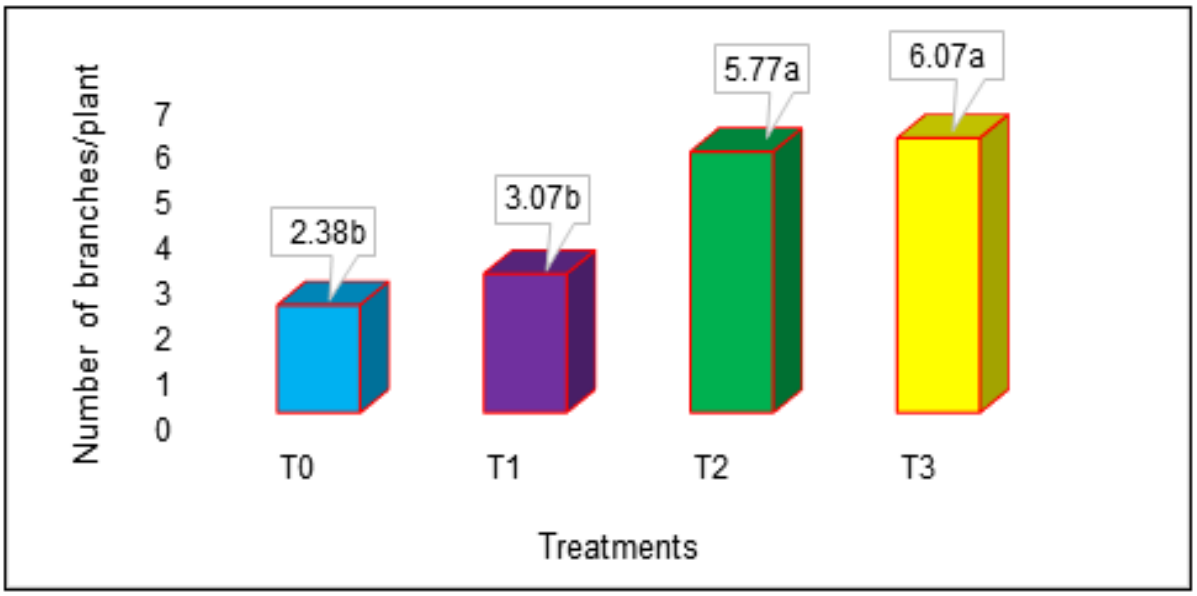
Fig. 2. Effects of Mulching and Staking on number of leaves/plant of Tomat.

Weight of fruits/plant (kg)

Significant variations were observed for weight of fruits/plant among the treatments (Table 1). Plastic mulch with staking treated plants produced average maximum weight of fruit (4.16kg) per plant followed by only staked plants (3.54kg), while the average minimum weight (1.65kg) was produced from the control. Mulched without staked plants gave 2.60kg/plant fruit yield.

The findings of the present investigation are in agreement with Kumar *et al.*, 2011 who found increased mean fruit weight of tomato by staking. In South-West Nigeria, Adeline, 1976 reported that staking increases fruit yield by 18 to 25% and Quinn, (1973) showed at Samaru, Nigeria that under wet conditions marketable yields were significantly increased by staking the tomato crop. Alam *et al.,* (2016) noticed that increased yield per plant is due to presence of more stem, increased number of clusters per plant, high fruit set percentage and large number of leaves which intern increases the photosynthetic activity and ultimately leads to higher yield per plant.

Singh and kamal, (2012) reported that tomato yield from plants grown on bare soil was significantly lower as compared to those grown with black plastic mulch and the yield increased under black plastic mulch was 21.7 to 29.8% higher as compared to bare soil. Pandey and Mishra, (2012) was found that black, blue and red polythene mulches increased tomato yield quality more than rice husk or sawdust mulches.



T_0= Control (Without mulching and staking), T_1= Mulching, T_2= Staking, T_3= Mulching and Staking, Similar letters are not differed at 5% probability and dissimilar letters are differed at 5% probability level.

Fig. 3. Effects of Mulching and Staking on number of branches/plant of Tomato.

Yield/plot (kg)

Treatments are significantly differed in terms of yield/plot (Table 1). Maximum number of yield/plot (49.03kg) were recorded from T_3 (Mulched with staked plants) in compared with only staked plants (T_2; 42.79kg) whereas lowest data (20.06kg) were noticed from control (T_0; without mulching and staking). The maximum yield produced by mulch was probably due to maintenance of optimal moisture in the soil; increased microbial activities etc. and decreased fertilizer leaching, and weeds infestation. On the contrary, less vegetative growth as well as low yield was obtained no mulch treatment. Under plastic mulch, temperature of soil was high and the weed was almost nil than other mulches, resulting higher yield of tomato.

This findings confirmed Mcewen, (1961) who reported that, staking and pruning increase marketable yield of tomatoes.

Conclusion

Tomato is one of the most popular vegetables effectively cultivated during the winter season in Bangladesh. Its production can be increased by adopting improved cultural practices. Mulching and staking are the effective means to reduce weed infestation, conserve moisture, support the plants, to keep the fruits and foliage off the ground, enhances the production of high quality fruits, prevents disease and fruit rot, allows better aeration, favorable soil biotic activities, reducing hard soil setting and contributing plant nutrients.

Results stated that, mulched and staked treated plants was better than other treatments in terms of plant height, number of leaves/plant, number of branches/plant, number of flowers/plant, number of fruits/plant, weight of individual fruits, weight of fruits/plant, yield/plot. Considering the results it can be concluded that mulched and staked treated plants more efficient for better growth and yield contributing characters in compared to other treatments.

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