

EFFECT OF SPACING AND STEM PRUNING ON THE GROWTH AND YIELD OF TOMATO

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Accepted for publication: 19 July, 2007

ABSTRACT

Ara, N., Bashar, M.K., Begum, S. and Kakon, S.S. 2007. *Effect of Spacing and Stem Pruning on the Growth and Yield of Tomato*. Int. J. Sustain. Crop Prod. 2(3): 35-39

The effect of spacing (40 and 50cm) and stem pruning (one stem, two stem, three stem and no pruning) on the yield was evaluated on indeterminate type BARI Tomato-6 variety at Regional Agricultural Research Station, Ishurdi, Pabna during 2005-2006. Wider spacing (50cm) gave the higher marketable yield (82.39 t/ha) and closer spacing gave the lowest marketable yield (68.32 t/ha) and number of fruits/plant. Two stem pruning yielded the highest marketable yield (87.18 t/ha) and one stem pruning gave the lowest number of fruits/plant. But stem pruning also yielded the lowest marketable weight of fruits/plant. Wider spacing coupled with two stem pruning showed superior interaction (97.08 t/ha) to others.

Keywords: Spacing, stem pruning, growth and yield

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill) belongs to the family Solanaceae and is a self crossing annual crop. It is a good source of vitamins (A and C) and minerals (Hobson and Davies, 1971; Kallou, 1991). It is also the dependable source of vitamin A, B, C and D, minerals, Ca, P and Fe (Islam, 1996). More than 7% of total vitamin-C of vegetable origin comes from tomato in Bangladesh (BBS, 1993). 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 country 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⁻¹) compared to the average yield (26.29t/ha) of the world as per FAO (2003). 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 (BBS, 2005).

Tomato is one of the most important crops widely grown, but yield variation was observed in different agro-ecological 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. Tomato yield in the tropics is much lower than that in the temperate zone due to several factors like high humidity high temperature, excessive rainfall, disease and pest (Villareal, 1980, Opena, 1985). Yield variation may be occurred due to variation in cultural practices. Plant spacing and stem pruning are the most important factors. Optimum plant spacing may help in proper utilization of land and for obtaining good quality fruits. On the other hand, stem pruning also may influence on the production of yield. Therefore, the present study was undertaken to investigate the effect of optimum plant density and suitable planning practice for higher yield and better quality of tomato.

MATERIALS AND METHODS

The trial was conducted at the Agricultural Research Station, Ishurdi, Pabna during the Rabi season of 2005-2006 in the Sara High land of gangetic flood plain soils. The experimental plot was laid out in Complete Randomized Block Design (factorial) with three replications. The tomato variety BARI Tomato-6 was used as a test material. The soil of the experimental plot was clay loam in texture to the high gangetic river flood plain under AEZ 11 (FAO 1971). The selected plot was well-drained high land with p^H 8.5. In this trials, two plant spacings were S₁= 60cm x 40cm and S₂= 60cm x 50cm, and four types of prunings were P₁= one stem pruning, P₂= two stem pruning, P₃= three stem pruning and P₀ = no pruning. The unit plot size was 2.4m x 1.0m. The seeds were sown in seed bed on October, 19, 2005 and transplanted in the main field on November, 15, 2005. Seed beds were mulched with rice straw immediately after seed sowing for moisture conservation. When seedling emerged, the rice straw was removed and the seedlings were covered with nylon net to protect them from strong sunshine. Water was sprayed on the seed bed when necessary after the emergence of true leaves, thinning was done by hand for retaining the strongest seedling in each pit. Ripcord 10% EC (cypermethrin) and Dacnil 75% WP (chlorothalonil) were applied @ 1.5 ml and 2g/l of water, respectively at seven days interval after germination to control insect and disease. Manures and fertilizer were applied at the rate of 8-12 ton cowdung, 500-600kg Urea, 400-500kg TSP and 200-300kg MP per hectare (Anonymous, 2004). 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. Pruning was done by scissars 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 (Iprodione) 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 10 randomly selected plants per plot. Data were recorded on days to 1st flowering, days to 50% flowering, plant height, number of cluster per plant, number of flower per cluster, fruit set (%), virus (%), fruit worm (%), southern blight (%), fruit length, fruit width, fruit wall thickness, number of locules, brix (%), crack (%), number of marketable fruit per plant, number of unmarketable fruit per plant, weight of marketable fruit per plant, weight of unmarketable fruit per plant, single fruit weight, marketable and non marketable 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 (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Horticultural characteristics

Horticultural characteristics are presented in Table 1 and 2. In spacing, wider spacing gave higher plant height (133.33cm). Similar results were also reported by Gupta and Shakla (1977). In case of stem pruning, one stem pruning produced the tallest plant (143.8cm) and shortest plant height (114.08cm) was obtained in no pruning. This result is the same trend with the findings of Uddin *et al.* (1997). Significantly highest number of cluster per plant (11.0) attained in wider spacing. The number of fruit cluster per plant was decreased as the closer spacing. The number of fruit cluster per plant decrease with the increase in severity of pruning. Significantly highest number of cluster per plant (16.70) was obtained from no pruning. This result is an agreement with the findings of Uddin *et al.* (1997). Number of cluster per plant was responded significantly to spacing as well as pruning system. Interaction effect was found on number of cluster per plant. When wider spacing coupled with no pruning gave the highest number of cluster per plant (17.03). Significantly higher number of flower per cluster (8.0) was produced by closer spacing. This finding is similar to Uddin *et al.* (1997). One stem pruned plants produced the highest number of flower per cluster (9.15) while the unpruned plant produced the lowest number of flower per cluster (6.28). This same trend was also found by Uddin *et al.* (1997). Number of flower per cluster was influenced significantly as spacing as well as pruning system. No interaction effect was found in case of number of flower per cluster. Spacing had no effect on fruit set (%). But fruit set (%) was also significantly influenced by pruning system. The highest proportion of flowers formed fruit when the plants pruned as one stem (43.26%). Lim and Chen (1989) reported similar results. Interaction effect was found in fruit set (%), percentage of fruit setting was attained highest (47.02%). On tomato when one stem pruning coupled with wider spacing. Spacing had no influence on virus, fruit worm and southern blight. Interaction effect had no virus percentage. Percentage of fruit damage by fruit worm and southern blight were statistically similar among the spacing and pruning system.

Table 1. Effect of spacing and stem pruning on Horticultural characteristics, disease and insect infested plants and fruit of Tomato

Treatment	Days to 1st flowering	Days to 50% flowering	Plant height (cm)	Number of cluster/plant	Number of flower/cluster	Fruit set (%)	Virus (%)	Fruit worm (%)	Southern blight (%)
Spacing									
40cm (S ₁)	49.66	57.00	130.77	9.4b	8.0a	34.28	0.16	0.50	0.33
50cm (S ₂)	49.58	57.41	133.33	11.0a	7.38b	36.02	0.00	0.33	0.33
F-test	NS	NS	NS	*	*	NS	NS	NS	NS
Pruning									
One stem puring (P ₁)	51.33a	61.0a	143.80a	6.45d	9.15a	43.26a	0.00b	0.50	0.33ab
Two stem puring (P ₂)	47.33c	54.0c	134.00b	7.88c	7.67b	36.39b	0.33a	0.33	0.16b
Three stem puring (P ₃)	49.00b	56.1b	136.30b	8.88b	7.20c	38.39b	0.00b	0.50	0.83a
No pruning (P ₀)	51.33a	57.6b	114.08c	16.70a	6.28d	22.57c	0.00b	0.33	0.00b
F-test	*	*	*	*	*	*	*	NS	*

In a column, similar letter(s) do not differ significantly at 5% level of significance.

Table 2. Interaction effect on spacing and stem pruning on Morphological characteristics, disease and insect infested plants and fruit of Tomato

Treatment	Days to 1st flowering	Days to 50% flowering	Plant height (cm)	Number of cluster/plant	Number of flower/cluster	Fruit set (%)	Virus (%)	Fruit worm (%)	Southern blight
S ₁ P ₁	51.33	61.66	146.53	5.20 e	9.47	30.07 c	0.00 b	0.33	0.66
S ₂ P ₁	47.33	53.33	134.20	7.57 d	8.03	47.02 a	0.66 a	0.66	0.00
S ₁ P ₂	49.00	56.00	136.40	8.47 c	7.30	38.45 b	0.00 b	0.33	0.66
S ₂ P ₂	51.00	57.00	116.20	16.37 a	6.30	21.58 d	0.00 b	0.66	0.00
S ₁ P ₃	50.66	60.33	136.20	7.70 cd	8.83	42.71 ab	0.00 b	0.66	0.00
S ₂ P ₃	47.00	54.66	133.86	8.20 cd	7.30	39.50 b	0.00 b	0.00	0.33
S ₁ P ₀	49.00	56.33	141.06	9.30 b	7.13	38.32 b	0.00 b	0.66	1.00
S ₂ P ₀	51.66	58.33	111.96	17.03 a	6.27	23.57 d	0.00 b	0.00	0.00
F-test	NS	NS	NS	*	NS	*	NS	NS	NS

In a column, similar letter(s) do no differ significantly at 5% level of significance.

Fruit characteristics

Fruit characteristics are presented in Table3 and 4. Plant spacing had no influence on any characters except fruit wall thickness. In case of pruning, significance variations were observed in fruit length, fruit width, fruit wall thickness, number of locules and Brix %. Significantly highest fruit length (6.08cm) was obtained from one stem pruning. This result is agreement with the findings of Uddin *et. al.* (1997). Highest fruit width (6.36cm) was produced by one stem pruning which was statistically similar to two stem pruning (6.27cm). Significantly highest fruit wall thickness (0.80cm) was also obtained from one stem pruned. This is an agreement with the findings of Uddin *et. al.*, (1997). Highest number of locules (5.11) was found in no pruning which was significantly differed with the all other treatments. Significantly highest Brix (4.80%) was recorded in two stem pruning. Interaction affects influenced on fruit wall thickness.

Table3. Effect of spacing and stem pruning on fruit characteristics of Tomato

Treatment	Fruit length (cm)	Fruit width (cm)	Fruit wall thickness (cm)	Number of locales	Brix (%)	Crack (%)
Spacing						
40cm (S ₁)	5.34	6.00	0.60 b	4.63	4.64	None
50cm (S ₂)	5.41	5.96	0.68 a	4.75	4.60	None
F-test	NS	NS	*	NS	NS	-
Pruning						
One stem puring (P ₁)	6.08 a	6.36 a	0.80 a	4.46 c	4.59 b	None
Two stem puring (P ₂)	5.39 b	6.27 a	0.70 b	4.48 c	4.80 a	None
Three stem puring (P ₃)	5.24 c	5.67 b	0.60 c	4.70 b	4.50 b	None
No pruning (P ₀)	4.80 d	5.61 b	0.45 d	5.11 a	4.59 b	None
F-test	*	*	*	*	*	-

In a column, similar letter(s) do no differ significantly at 5% level of significance.

Table 4. Interaction effect of plant spacing and stem pruning on fruit characteristics

Treatment	Fruit length (cm)	Fruit width (cm)	Fruit wall thickness (cm)	Number of locules	Brix (%)	Crack (%)
S ₁ P ₁	6.08	6.26	0.73 b	4.40	4.63	None
S ₂ P ₁	5.38	6.43	0.73 b	0.56	4.83	None
S ₁ P ₂	5.23	5.67	0.56 c	4.63	4.50	None
S ₂ P ₂	4.70	5.63	0.46 d	5.10	4.60	None
S ₁ P ₃	6.08	6.28	0.86 a	4.53	4.55	None
S ₂ P ₃	5.40	6.30	0.66 bc	4.56	4.78	None
S ₁ P ₀	5.25	5.66	0.63 bc	4.76	4.51	None
S ₂ P ₀	4.91	5.60	0.43 d	5.13	4.58	None
F-test	NS	NS	*	NS	NS	

In a column, similar letter(s) do no differ significantly at 5% level of significance.

Yield and yield components

Yield and yield components characteristics are presented in Table 5 and 6. In case of spacing, significant variation was observed in number of marketable fruit per plant. 50cm spacing gave higher number of marketable fruits (21) per plant. The results are in agreement with Vittum and Tapley (1957). Spacing had effect on the

number of unmarketable fruit per plant. But wider spacing produced significantly higher number of unmarketable fruit (5.72) per plant. This result is in conformity with the findings of Uddin *et al.* (1997). Two stem pruning plant gave the highest number of marketable fruits (21) per plant and one stem pruned plants gave the lowest (16). Lim and Chen (1989) found similar findings. Pruning treatments also had significantly influenced on higher number of unmarketable fruit per plant. Weight of marketable fruit per plant was also affected by spacing. Higher yield (1.99t/ha) was obtained from wider spacing. Marketable yield increased as planting density increased. This result is in agreement with the findings of Huerres *et al.* (1987). Similar results were also reported by Vittum and Tapley (1957) and Gupta and Shakla (1977). Two stem pruned plants gave the highest marketable weight of fruit per fruit per plant (2.11kg). No stem pruning gave the lowest (1.42kg) marketable weight of fruit per plant. This result is in agreement with the findings of Uddin *et al.* (1997). Spacing had significant effect on unmarketable weight of fruit per plant. Wider spacing gave the higher number of unmarketable fruit per plant (224.58g). This result is the same trend with the findings of Uddin *et al.* (1997). The highest unmarketable fruit weight (240g) was obtained from one stem pruned plant while unpruned plant gave the lowest (161.17g). The results obtained corroborated with the findings of Udin *et al.* (1997). Single fruit weight was significantly higher obtained from one stem pruning (111.17g) and lower from unpruned plant (79.33g). This finding was almost in agreement with the reported bny Uddin *et al.* (1997). Significantly single fruit weight (111.17g) was obtained from wider spacing. Similar results are also found by Vittum and Tapely (1957) and Roy *et al.* (1954). Wider spacing gave the higher marketable yield (82.39 t/ha). Significantly highest yield (87.18 t/ha) was obtained from two stem pruning. Unpruned gave the lowest yield (58.65t/ha). Lim and Chen (1989) and Uddin *et al.* (1997) found similar results. Interaction affects on weight of marketable fruits per plant (Table 6). Significantly highest marketable weight of fruits per plant (2.33 kg) when two stem pruned plant coupled with wider spacing. Interaction affects on marketable yield (t/ha). Significantly highest marketable yield (97.08 t/ha) was also obtained when two stem pruned plant coupled with wider spacing.

Table 5. Effect of spacing and stem pruning on yield and yield components of Tomato

Treatment	Number of fruit/plant		Weight of fruit/plant		Single fruit weight (g)	Yield (t/ha)	
	Marketable	Unmarketable	Marketable (kg)	Unmarketable (g)		Marketable	Unmarketable
Spacing							
40cm (S ₁)	18.0 b	4.97 b	1.65 b	188.25 b	92.42 b	68.32 b	7.84 b
50cm (S ₂)	21.0 a	5.72 a	1.99 a	244.58 a	111.17 a	82.39 a	9.35 a
F-test	*	*	*	*	*	*	*
Pruning							
One stem puring (P ₁)	16.0 c	4.22 c	1.90 b	240.0 a	117.83 a	78.17 b	9.99 a
Two stem puring (P ₂)	21.0 a	4.77 c	2.11 a	209.17 b	105.67 a	87.18 a	8.70 b
Three stem puring (P ₃)	20.5 a	5.58 b	1.87 b	215.3 b	104.33 a	77.43 b	8.95 b
No pruning (P ₀)	17.0 b	6.82 a	1.42 c	161.17 c	79.33 b	58.65 c	6.71 c
F-test	*	*	*	*	*	*	*

In a column, similar letter(s) do no differ significantly at 5% level of significance.

Table 6. Interaction effect of plant spacing and stem pruning on yield and yield components of Tomato

Treatment	Number of fruit/plant		Weight of fruit/plant		Single fruit weight (g)	Yield t/ha	
	Marketable (kg)	Unmarketable (g)	Marketable (kg)	Unmarketable (g)		Marketable (kg)	Unmarketable (g)
S ₁ P ₁	17.5 cd	3.97	1.90 b	161.0 e	118.0 a	79.16 b	7.91 b
S ₂ P ₁	16.0 d	4.43	1.89 b	190.0 d	117.67 a	78.74 b	7.66 b
S ₁ P ₂	21.0 ab	5.13	1.79 b	209.3 c	117.60 a	74.58 b	8.70 ab
S ₂ P ₂	21.96 a	6.37	2.33 a	198.0 cd	109.0 ab	97.08 a	8.24 ab
S ₁ P ₃	19.0 bc	4.47	1.91 b	161.3 e	99.67 ab	79.58 b	6.70 c
S ₂ P ₃	20.0 a	5.10	1.95 b	233.67 a	100.0 ab	81.24 ab	9.73 a
S ₁ P ₀	15.9 d	6.03	1.05 c	221.33 b	68.67 c	43.72 c	9.22 a
S ₂ P ₀	20.9 ab	7.27	1.79 b	184.67 de	86.67 b	74.58 b	7.67 b
F-test	*	NS	**	**	*	**	**

In a column, similar letter(s) do no differ significantly at 5% level of significance.

REFERENCES

- Anonymous. 2004. Krishi Rrojukti Hatboi (Handbook on Agrotechnology). 3rd Edition, Bangladesh Agricultural Research Institute, Gazipur-1701, Bangladesh. p. 325.
- BBS, 2005. Statistical year Book of Bangladesh, Stat. Div., Minis. Planning, Govt. People Republic of Bangladesh, Dhaka.
- FAO. 1971. Food and Agriculture organization of the United Nations, Soil Survey Project of Bangladesh, Soil Res. Tech. Rep. pp. 101-159.
- FAO. 2003. Food and Agriculture Organization of the united Nations, Soil Survey Project of Bangladesh, Soil Res. Tech. Rep. vol. 57. pp. 140-141.
- Gomez, K. A., and A.A. Gomez, 1984. Statistical procedure of Agricultural Research. John Wiley and Sons. Inc. Newyork. pp 67-215.
- Gupta, A and V. Shulkla. 1977. Response of tomato (*Lycopersicon esculentum Mill*) to plant spacing, nitrogen, phosphorus and potassium fertilizer. Indian. J. Hort., 34 (3): 270-276.
- Hobson, G. and J. N. Davies, 1971. The Tomato. The Biochemistry of Fruits and their Products. Hulme (ed) Academic press, New York. London. vol. 2 pp. 337-482.
- Huerres perez, C; L.N. Caraballo and J. Margolles. 1987. Effect of planting distance and number of plants per cluster in 3 cultivars of processing tomatoes (*Lycopersicon esculentum, Mill*). Centro Agricola. 14:(3):21-30.
- Islam. M.A. A.M. Farrooque, A Siddiqua and A.Siddique 1996. Effect of planting patterns and different nitrogen levels on yield and quality of tomato, Bangladesh. J. Agril. Sci., 24(1): 4-5.
- Kaloo, G. 1991. Genetic Improvement of Tomato, Springer verlag, Berlin Heidelberg, Germany. p. 358
- Lim, E.S. and S.T. Chen, 1989. Hydroponic production studies on Lowland Tomato in Malaysia: The effect of pruning system and CHPA application on yield. In: Tomato and pepper production in the Tropics. Proc. Intern. Symp, Integrated management practices, March 21-26, AVRDC. Shanhua, Taiwan. pp 358-364
- Opena, R.T. 1985. Development of Tomato and Chinese Cabbage cultivars adapted to the Hot, Hamid tropics, Acta Hort., 153: 421-436.
- Roy, R.S., R.K. Singh and M.F. Bari. 1954. Effect of spacing on growth and fruiting of tomato var. Marglobe. Ind. J. Hort., 11: 131-37.
- Villareal, R. L. 1980. Tomatoes in the Tropics. Boulder, Colorado: USA, west view press, 10 p.
- Vittum, M. T. and W. T. Tapley. 1957. Spacing and fertility level studies with a paste type tomato. Proc, Amer. Soc. Hort. Sci., 69: 323-26.
- Uddin. M. R. Hossain, M. A. Mian, M. A. K. Uddin M. Z. Reza and A.K.M. Mahtabuddin. 1997. Effect of stem pruning and spacing on the growth and yield of Tomato. Bangladesh Hort., 25 (1&2): 41-46