Plant Archives Vol. 24, No. 2, 2024 pp. 2139-2144 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org

DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2024.v24.no.2.308

INFLUENCE OF ORGANICS ON GROWTH AND YIELD OF TOMATO (*LYCOPERSICON ESCULENTUM* MIL L.)

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(Date of Receiving-06-04-2024; Date of Acceptance-22-06-2024)

ABSTRACT

A field experiment was conducted to investigate the growth and yield performances of tomato under various organic treatments at, Biswanath College of Agriculture, Assam Agricultural University, Biswanath, Chariali during 2020-2021. The experiment was laid out in Randomized Block Design with thirteen treatments replicated thrice. The results revealed that morphological and yield attributing parameters, as well as yield was significantly influenced by various organic treatments. The organic treatment Enriched compost≈@10t/ha FYM + 10% Cow urine + 10% Dung brew spray recorded the highest plant height (38.73 and 72.65 cm), number of branches (3.50 and 6.12) at 30 days after transplanting (DAT) and at 1st harvest, respectively, number of functional leaves at 30 DAT (18.83) and 45 DAT (25.83), number of fruiting cluster/plant (5.88), fruits/cluster (4.67), number of fruits/plant (27.46), fruit diameter (5.50 cm), fruit weight (33.46 g), fruit yield (35.11 t/ha. Considering the superior morphological and yield attributing characters, yield and B:C ratio amongthe organic treatments, Enriched compost≈@10t/ha FYM + 10% Cow urine + 10% Dung brew spray can be used by farmers for organic tomato production in Assam condition.

Key words : Tomato, Organic, Growth, Yield.

Introduction

Tomato (*Lycopersicon esculentum* Mill.) is an important day neutral warm season fruit vegetable belongs to the Solanaceae family with chromosome number 2n=24. Tropical America (Peru) is the origin of tomato. Fruit type is berry and flowers are borne in cluster. Tomatoes are considered as protective foods due to their high concentrations of minerals and vitamins as well as healthy organic acids like citric, formic and acetic acids (Hari, 1997). Tomato also contains lycopene, â-carotene, phenols and flavonoids. In India, tomatoes are regarded as “Poor man’s oranges,” whereas in England, it is known as “Love of Apple” (Selvakumar, 2014). Tomato consumption lowers the risk of different kinds of cancers, osteoporosis and cardiovascular diseases. Some studies show that tomatoes and garlic should be taken together at the same time to have its cancer preventive effects (Bhowmik *et al*., 2012). It is used in a variety of ways including raw as a salad or cooked, processed products like pickles, ketchup, puree, sauces and paste. Tomato is a good appetizer and its soup is a good remedy for preventing constipation (Gopalkrishnan, 2007).

Chemical fertilizers are harmful to both humans and the environment, even though their use is increasing day by day because of their higher yield when compared to organic fertilizers. The cost of inorganic fertilizers is also expensive, making them unaffordable for certain small and marginal farmers. Organic manures are prepared from human and animal waste, vegetable compost, agricultural residues *etc*. that provide essential plant nutrients, and improves the fertility of soil and organic carbon (Brar *et al*., 2019). Nowadays, the majority of

consumers are expecting organic food for good nutritional value without any chemical residues (Ditlevsen *et al*., 2019). However, its production is very low throughout the country.

In Assam, organic farming occupies in a decent amount but people are still dependent on chemical fertilizers. Considering the detrimental effect of chemical fertilizers emphasis is given on organic production of tomato to prevent the hazards of chemical fertilizer. Based on this, the experiment was conducted to determine the best organic treatment on the basis of quantitative traits as well as yield and yield attributing parameters of the tomato.

Materials and Methods

The study was conducted at the Instructional cum Research farm, Department of Horticulture, Biswanath College of Agriculture, Assam Agricultural University, Biswanath, Chariali during 2021-2022. The experimental site was located at 26.7°40′44″ N latitude and 93.1° 98′ 42″E longitude at an elevation of 105 m above mean sea level. The experimental plot has a good slope with proper drainage system. The soil was sandy loam with pH 5.35, organic carbon 0.72% and available N, P and K were 537.60, 46.16 and 204.28 kg ha^{-1}. The experiment was composed of 13 treatments *viz*. T_1: RDF (N:P:K @ 75:60:60 kg/ha), T_2: FYM @ 10t/ha, T_3: Vermicompost≈@10t/ha FYM, T_4: Enriched compost≈@ 10t/ha FYM, T_5: FYM @ 10t/ha + 10% Cow urine spray, T_6: Vermicompost≈ @ 10t/ha FYM + 10% Cow urine spray, T_7 : Enriched compost≈@ 10t/ha FYM + 10% Cow urine spray, T_8: FYM @ 10t/ha + 10% Dung brew spray, T_9: Vermicompost≈ @ 10t/ha FYM + 10% Dung brew spray, T_{10}: Enriched compost≈@ 10t/ha FYM + 10% Dung brew spray, T_{11}: FYM @10t/ha + 10% Cow urine + 10% Dung brew spray, T_{12}: Vermicompost≈ @10t/ha FYM +10% Cow urine + 10% Dung brew spray and T_{13}: Enriched compost ≈ @10t/ha FYM + 10% Cow urine + 10% Dung brew spray. The treatments were laid out in Randomized Block Design with 3 replications. Twelve treatments (T_2, T_3, T_4, T_5, T_6, T_7, T_8, T_9, T_{10}, T_{11}, T_{12}, T_{13}) were laid in the certified organic block, which was certified in the year of 2006 by APOF organic certification agency and was maintained for the last 15 years. The treatment T_1 (recommended dose of fertilizer) was laid out outside the organic block. Altogether thirty-nine plots of equal dimension (3.75 m × 1.2 m) were made for the experiment. The seedlings were first raised in nursery which was prepared by sterilizing the soil with the Bio-Veer and well rotten powdered farm yard manure was applied and incorporated into the soil. Healthy, uniform and vigorous 30 days oldseedlings of variety 'Pusa Ruby' were selected for transplanting at a spacing of 75 cm × 30 cm incorporating 20 numbers of plant per plot. The experimental plot was thoroughly ploughed by tractor followed by harrowing and brought to a fine tilth by repeated harrowing and levelling. Each plot was broadcasted with the recommended treatments mixed with top soil. Organic manure like FYM, Vermicompost and Enriched compost was incorporated 6-7 days prior to transplanting. FYM which is a decomposed mixture of the solid and liquid excreta of farm animals along with litters and left-over materials from roughages or fodder fed to the cattle was applied in each recommended plot @ 4.5 kg and Vermicompost @ 0.97 kg. Vermicompost is the product of the decomposition process using various species of earthworms, to create a heterogeneous mixture of decomposing vegetable or food wastes, bedding materials and vermicast. Enriched compost was prepared by mixing organic materials of plant-based origin with rock phosphate and in each recommended plot 1.87 kg of enriched compost was applied. Liquid manure used was Cow urine and Dung brew. Cow urine is a unique product of dairy compared to other organic sources with extensive manure, antimicrobial and disinfectant properties. Ten percent (10%) cow urine spray was done 3 times at 10 days interval from 20 days after transplanting in each recommended plot.

Dung brew is a fermented solution of cow dung that provides nutrition to the plant. It was prepared by adding 5 kg of cattle dung and 15 litres of cattle urine in a 20 litres plastic bucket and mixed well. After that, covered the bucket with a gunny sack for providing sufficient aeration and stirred the materials every alternate day for 15 days. The dung brew was ready for spray after 15 days. In each recommended plot 10 percent of dung brew was sprayed 3 times at 10 days intervals from 20 days after transplanting on the foliage of the crop. Also, each 10 per cent cow urine spray and 10 per cent dung brew spray were done 3 times alternately at 10 days intervals from 20 days after transplanting in every recommended plot. The recommended dose of inorganic fertilizer for tomato in Assam condition *i.e.*, N:P:K @ 75:60:60 kg/ha in the form of Urea, SSP and MOP, respectively were applied along with the FYM @ 10 t/ha. FYM was applied as basal and half of N and full doses of P_2O_5 and K_2O were applied at the time of final land preparation. The remaining dose of N was top dressed at 30 days after transplanting. Timely intercultural operations were performed as per package of practice. Neem oil, bio-meta and tobacco-garlic extract were sprayed to control

insect pests and to protect the crop from viral infection in the organic plot. Also, the Bordeaux mixture was applied to protect the crop from infection of late blight. In inorganic plot, Blitox and neem oil was sprayed to control the diseases and pest. Observation on different parameters were taken as per standard procedure and the benefit: cost ratio was computed from the net profit and total cost of cultivation. The significance of the variance due to treatments was determined by calculating the respective 'F' values by following the method described by Panse and Sukhatme (1985). The significance of the difference between mean values of the character of the treatment was tested by computing critical difference (CD) estimates.

Results and Discussion

Significant differences were recorded among all the treatments with respect toplant height, number of branches and functionalleaves in the plants (Table 1). The maximum plant height (39.80 and 73.80 cm at 30 DAT and at 1st harvest, respectively) was recorded in the inorganic treatment T_1 with RDF, which was followed by organic treatment T_{13} *i.e.* Enriched compost≈@10t/ha FYM +10% Cow urine + 10% Dung brew spray (38.73 and 72.65 cm), while the minimum plant height of 31.96 cm and 66.13 cm at 30 DAT and at 1st harvest was recorded in organic treatment T_2 (FYM @10t/ha). Among the various treatments, the highest number of branches were recorded in T_1 (3.83 and 6.33) at 30 DAT and at 1st harvest, respectively) which was followed by T13 (3.50 and 6.12) and the lowest number of branches (2.16 and 3.41) was recorded in T_2. The maximum number of functional leaves per plant at 30 DAT was recorded in T_1 (19.83), which was at par with T_{13} (18.83). Similarly, at 45 DAT also T_1 (26.83) recorded the maximum number of functional leaves per plant followed by T_{13} (25.83). Whereas, the minimum number of functional leaves were recorded under the treatment T_2.

Maximum plant height, highest number of branches and number of green leaves in plants grown in inorganic treatment T_1 (Recommended dose of fertilizer) might be due to the effect of chemical fertilizers that supply the nutrients inavailable forms to the plants immediately after application and more particularly withrespect to nitrogen which helped in increasing the plant height, number of branches andleaves. Chatterjee *et al.* (2014) reported that the increase in plant height with 100 per cent inorganic fertilizers was dueto a direct result of the higher amount of inorganic nitrogen, which is a necessarycomponent of the protein and chlorophyll molecules. These results are in conformity with the findings of Solaiman and Rabbani (2006).

Among the organics, morphological characters *viz.*, plant height, number ofbranches and leaves were increased when the plants were treated with Enrichedcompost≈@10t/ha FYM + Cow urine (10%) + dung brew spray (10%). Since inenriched compost more nutrients are available compared to vermicompost and FYM, hence they could improve the soil health and fertility

Table 1 : Influence of organics on growth parameters of tomato.

Treatments	Plant height (cm)		Number of branches		Number of functional leaf per plant		Days to first flowering	Days to first harvest
	30DAT	At 1st harvest	30 DAT	At 1st harvest	30 DAT	45 DAT		
T_1	39.80	73.80	3.83	6.33	19.83	26.83	30.02	71.02
T_2	31.96	66.13	2.16	3.41	11.50	18.50	25.00	60.56
T_3	32.85	66.76	2.33	3.57	15.16	22.16	26.43	61.16
T_4	34.06	68.06	2.46	3.79	15.50	22.50	27.75	62.01
T_5	36.13	70.05	2.72	4.80	17.00	24.00	27.62	66.01
T_6	36.16	70.16	2.83	4.91	17.50	24.50	27.75	66.56
T_7	37.50	71.50	3.00	5.01	17.83	24.83	28.02	67.56
T_8	34.21	68.21	2.52	3.96	16.00	23.00	26.51	62.60
T_9	34.63	68.28	2.60	4.13	16.16	23.16	26.57	63.49
T_{10}	34.83	68.41	2.66	4.46	16.50	23.50	27.43	64.01
T_{11}	37.90	71.81	3.16	5.27	18.00	25.00	28.15	68.01
T_{12}	38.36	72.28	3.30	5.56	18.50	25.50	28.21	69.01
T_{13}	38.73	72.65	3.50	6.12	18.83	25.83	29.25	70.30
S Ed ±	0.42	0.46	0.03	0.02	0.49	0.34	0.02	0.22
CD (P=0.05)	0.88	0.94	0.06	0.04	1.01	0.70	0.04	0.45

in better way than thevermicompost and FYM could do.Again enriched compostalong with 10% cow urineand 10% dung brew performed better than other organic treatmentsbecause cow urine and dung brew contain a variety of macro & micro nutrients andother beneficial components so they could act as bio-fertilizer, bio-pesticides and mayimprove soil fertility as well as may reduce pest and disease problem and thus might have improved the growth and development of plant.

Different treatments showed significant differences on the days to first flowering and days to first harvest. (Table 1.) Among all the treatments T_2 recorded the minimum number of days to first flowering (25.00) and first harvest (60.56), which was followed by T_3 and T_4 while the maximum number of days to first flowering (30.02) and first harvest (71.02) was recorded in T_1.

The superiority of treatment T_2 (FYM @ 10t/ha) might be because of the fact that FYM contains a sufficient amount ofmicro and macro nutrients which are attributed to the accelerated vegetative growth enhancement and the storage of enough food reserves for the differentiation of vegetative buds intoflower buds resulting in early flowering and fruiting. Organic substances improved the biological activities of microorganisms, which improved the plants reproductive responses resulting in lesstime for flower initiation (Parmar *et al.*, 2019).

In the present study, it was observed that there was significant variation in yield attributing parameters among the different organic treatments and inorganic treatment (Table 2). The maximum number of fruiting clusters (6.32) and fruits (28.25) per plant was recorded in T_1, which was followed T_{13} (5.88 and 27.46) and the minimum was recorded in T_2 with a value of 4.01 and 16.88, respectively. Among all the treatments (both organic and inorganic) T_{13} recordedthe maximum number of fruits per cluster (4.67), maximum fruit diameter (5.50 cm) and maximum weight of fruit (33.46 g). The minimum number of fruits per cluster (4.21) and minimum fruit diameter (3.63 cm) was recorded in T_2, while the minimum fruit weight was recorded in T_3 (25.45 g).

Similarly, fruit yield/plant and total yield was significantly influenced by the treatments (Table 2). The maximum fruit yield/plant (0.799 kg) and total yield (35.51 t/ha) was recorded in T_1 followed by T_{13} (0.790 kg and 35.11 t/ha). The minimum value was recorded in T_2 (0.504 kg and 22.40 t/ha). The higher yield per plant and total yield (t/ha) obtained in T_1 (recommended doses of fertilizer) was obviously due to the increase in number of fruiting clusters and fruits per plant. The increased yield and yield attributes with inorganic fertilizers might be because of rapid availability and utilization of N, P and K for various internal plant processes for carbohydrate production and relatively higher amount of carbohydrate could have promoted the growth rate and in turn increased the yield of tomato. The another reason might be due to production of higher number of leaves have increased the total chlorophyll content production leading to more carbohydrate synthesis, which resulted higher yield per plant and per hectare.

It was observed that among the organic treatments,

Table 2: Influence of organics on yield and yield attributing traits of tomato.

Treatments	Number of fruiting cluster/ plant	Number of fruits/ clusters	Number of fruits/ plants	Fruit diameter (cm)	Fruit weight (g)	Fruit yield/ plant(kg)	Yield (t/ha)
T_1	6.32	4.47	28.25	4.82	31.91	0.799	35.51
T_2	4.01	4.21	16.88	3.63	31.89	0.504	22.40
T_3	4.23	4.33	18.32	3.75	25.45	0.563	25.02
T_4	4.53	4.30	19.48	3.92	27.15	0.615	27.33
T_5	4.90	4.17	20.43	4.12	29.13	0.679	30.17
T_6	5.32	4.31	22.93	4.23	30.79	0.691	30.71
T_7	4.98	4.40	21.91	4.48	30.26	0.698	31.03
T_8	4.95	4.25	21.04	4.00	31.75	0.623	27.68
T_9	4.36	4.26	18.57	4.07	26.33	0.648	28.80
T_{10}	5.60	4.42	24.75	4.34	31.85	0.676	30.04
T_{11}	5.20	4.33	22.52	4.68	31.98	0.729	32.40
T_{12}	5.67	4.55	25.80	4.71	33.42	0.728	32.35
T_{13}	5.88	4.67	27.46	5.50	33.46	0.790	35.11
SEd ±	0.03	0.01	0.01	0.03	0.01	0.002	0.03
CD(P=0.05)	0.07	0.02	0.02	0.06	0.02	0.004	0.06

Table 3: Economics of production.

Treatments	Total cost of cultivation (Rs.)	Yield (t/ha)	Gross Return (Rs.)	Net profit (Rs)	B: C ratio
T_1	1,14,880.00	35.51	5,32,650.00	4,17,770.00	3.63
T_2	1,11,700.00	22.40	336,000.00	2,24,300.00	2.01
T_3	106,300.00	25.02	3,75,300.00	269,000.00	2.53
T_4	113,200.00	27.33	409,950.00	2,96,750.00	2.62
T_5	1,19,250.00	30.17	4,52,550.00	3,33,300.00	2.79
T_6	1,37,250.00	30.71	5,26,650.00	3,89,400.00	2.83
T_7	1,20,750.00	31.03	4,65,450.00	3,44,700.00	2.85
T_8	1,19,450.00	27.63	4,14,450.00	295,000.00	2.46
T_9	114,050.00	28.80	432,000.00	317,950.00	2.78
T_{10}	1,20,950.00	30.04	4,50,600.00	3,29,650.00	2.72
T_{11}	127,000.00	32.40	486,000.00	359,000.00	2.82
T_{12}	1,21,600.00	32.35	4,85,250.00	3,63,650.00	2.99
T_{13}	1,13,850.00	35.11	4,60,650.00	3,46,800.00	3.04

*Selling price of tomato@ Rs. 15/kg.

yield and yield attributing characters were higher in T_{13} (Enriched compost≈@10t/ha FYM +10% Cow urine + 10% Dung brew spray). The variation of the values of these parameters among the different organic treatments might be due to the organic formulations prepared with different organic sources. Since cow urine and dung brew contain a variety of macro & micro nutrients as well as other advantageous components, so they could act as bio-fertilizer, bio-pesticides and may improve soil fertility as well as may reduce pest and disease problem and thus could improve the growth and development of plant. The production of higher number of fruits under organic treatments could be attributed due to balanced use of nutrient enhancement rhizospheric effect and soil biological activity, thereby provided congenial physical condition of soil (Biswas *et al*., 1971). So, with balanced application of nutrients is advocated for better quality of fruits might have enhanced the metabolism, transformation of carbohydrates, enzymatic activity and protein synthesis favoured greater absorption and translocation of nutrients and accumulation of dry matter to different plant parts or repository sites. This might be the reason for which the numberof fruits and yield of tomato plants might have increased in the present study. The uptake of nutrients from soil helped the plants to produce more carbohydrates in theleaves which might have been translocated to the developing fruits resulting increased weight. It might be justified with the remark of Bertand and Cleyetmarel (2008), who reported that the positive effect of organic manures added to soil might be attributed to stimulate the activity of bacteria which promotes the released availability of N, P and the other nutrients in the soil and enhances nutrients absorption by tomato roots. Similar results were reported by Tu *et al.* (2006) and Singh *et al.* (2017).

In agricultural crop production, calculation of benefit-cost ratio is the most crucial factor that determines a treatments usefulness and acceptance by growers. The highest benefit: cost ratio (3.63) was achieved in T_1 (Table 3) because of maximum yield which was followed by T_{13} (3.04). Likewise, lowest benefit: cost ratio (2.01) was achieved in T_2 (FYM@10 t/ha) due to the lowest yield in this treatment.

Conclusion

Based on the investigation results, it was concluded that though plants treated with recommended dose of fertilizer (T_1) showed highest yield but among organics, plants treated with Enriched compost ≈ @10 t/ha FYM + Cow urine 10% + Dung brew 10% spray (T_{13}) was found superior over the other organic treatments which resulted in higher yield with a higher B: C ratio.

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