International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(6): 2537-2539

Received: 16-09-2018
Accepted: 22-10-2018

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Effect of various organic inputs on growth and its attributes of tomato (*Solanum lycopersicum* L.) cv. GS-600 under polyhouse condition

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Abstract
An investigation was carried out at Research Field, Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during Rabi season of 2017-18, to assess the effect of various organic inputs on growth and its attributes of tomato under polyhouse condition. The experiment was laid out in randomized block design with 10 treatments replicated thrice. The treatments consisted of different combinations of organic manures i.e., FYM, Vermicompost and Poultry manure. The data were collected from five randomly selected plant of each treatment and subjected to statistical analysis. The results reflected that among 10 treatments under study, treatment T_6 (Vermicompost 50% + Poultry manure 50%) was best in all characters and recorded maximum @ 30, 60, 90 and 120 DAT in term of plant height (56.68cm, 94.99cm, 199.44cm and 250.31cm, respectively), No. of branches per plant (6.00, 8.47, 15.47 and 25.93, respectively) and No. of leaves per plant (6.93, 12.67, 23.53 and 36.07, respectively); and better vegetative growth promoted the flowering by producing more clusters per plant with the application of Vermicompost 50% + Poultry manure 50% in treatment T_6 which were significantly highest in terms of number of clusters per plant (7.60), number of flowers per cluster (9.01) and number of flowers per plant (56.61); whereas similar trend was closely followed by the treatment T_7 (25% Vermicompost + 75% Poultry manure) for these traits, while the constantly lower performance in similar growth and flowering traits at all growth stages was recorded with treatment T_0 (Control). These findings are reliable for enhancing organic tomato production under protected cultivation.

Keywords: Tomato (*Solanum lycopersicon* L.), FYM, vermicompost, poultry manure

Introduction
Tomato (*Lycopersicon esculentum* L.) belongs to family *Solanaceae* having chromosome number (2n=24). It is a self-pollinated crop and Peru-Equador region is considered to be the centre of origin. Tomato was introduced by the Portuguese. Tomato is cultivated in tropics and subtropics of the world and it is being cultivated in kitchen gardens, commercial fields under green house and polyhouse conditions and soil less culture or hydroponic systems. Tomato is one of the popular vegetables of great commercial value and is used in various forms of salad, soup, ketchup, sauce, chutney, pickles, powder, paste, juice, puree, whole canned fruits. Tomato is a rich source of vitamins, minerals, organic acids, sugars, ascorbic acids, acidity and Iycopene (Beutner 2001) [1]. Consumption of tomato and its products can significantly reduce the risk of developing of colon, rectal, and stomach cancer. Recently studies suggest that tomatoes contain the antioxidant Lycopene, which markedly reduces the risk of prostate cancer (Kanwar 2011) [4]. Tomato juice promotes gastric secretion, acts as a blood purifier and works as intestinal antiseptic.

Tomato is most popular vegetable grown in the world. It can be grown under open as well as protected condition throughout the world for supplying in the fresh market as well as for processing. Tomato is thermo-sensitive crop and fruit set is adversely affected when night temperature falls below 13 °C or day temperature exceeds 30 °C. The optimum temperature required for this cultivation is 15 – 27 °C. Prevailing low temperature and frost injury winter are limiting factors in North India and hills to make their cultivation successful in winter and spring summer season, polyhouse is a vital solution. Due to erratic behavior of weather, the crops grown in open field are often exposed to fluctuating levels of temperature, humidity, wind flow etc. which ultimately affect the crop productivity adversely (Abdel-mawgoud 2007) [1]. Besides this, limited availability of land for cultivation hampers the vegetable production.

Hence, to obtain a good quality produce and production during off season, there is a need to cultivate tomato under protected conditions such as green house, poly house and net house etc. Green house have tremendous potential in increasing productivity of tomato (Chandra *et al*., 2000).

High productive ability of Tomato puts tremendous pressure on soil for removal of nutrients. Among the organic sources, the old age concept of nutrient application is the utilization of farm yard manure, vermicompost is easily prepared and much effective manure and Fresh poultry manure represents about 5% of live bird weight. These manures being good source of essential plant nutrients especially NPK and give good crop stand by virtue of improvement in physical, chemical and biological characteristics of the soil (Singh *et al.* 2017) [10].

Materials and methods

An experiment was conducted at Horticultural Experimental Field, Department of Horticulture, SHUATS, Prayagraj during Rabi season of 2017-18, to assess the effect of various organic inputs on growth and its attributes of tomato under polyhouse condition. The experiment was laid out in randomized block design with 10 treatments and each replicated thrice. The treatments involved were T_0-Control (Recommended dose of NPK @ 120:60:60), T_1- FYM (22 t/ha.), T_2-Vermicompost (5 t/ha.), T_3-Poultry Manure (6 t/ha.), T_4- FYM + Vermicompost @ (11t/ha + 2.5t/ha), T_5- FYM + Vermicompost @ (5.5t/ha + 3.75t/ha), T_6- Vermicompost + Poultry manure @ (2.5t/ha + 3t/ha), T_7- Vermicompost + Poultry manure @ (1.25t/ha + 4.5t/ha), T_8- FYM + Poultry manure @ (11t/ha + 3t/ha), T_9- FYM + Poultry manure @ (5.5t/ha + 4.5t/ha), where is RDF: Recommended Dose of fertilizers, FYM: Farm Yard Manure. The plot size was 1.8 x 1.2 m and spacing followed was 60 x 60cm. The soil of the experimental field was sandy loam in texture, poor in nitrogen, comparatively rich in phosphorus and medium in potash with slightly acidic reaction. The land was brought to a fine tilth through ploughing and tillage. Irrigation channels and bunds were maintained properly. Thirty days old healthy and uniform seedlings were transplanted. Light irrigation was given after transplanting. The organic manures were applied one week before transplanting, for proper decomposition, full dose of phosphorus and potassium and half dose of nitrogen as per treatment were applied just before the transplanting. The remaining half dose of nitrogen was applied 30 days after transplanting. All cultural practices were followed regularly during crop growth and observations were recorded at every 30 days interval (30, 60, 90 and 120DAT) on growth characters i.e., plant height, No. of branches, No. of leaves and flowering parameters like number of clusters per plant, number of flowers per clusters and number of flowers per plant were recorded from time to time. The data on these parameters were subjected to statistical analysis to draw logical conclusions.

Results and discussion

Growth parameters

The data revealed that the combination of different organic manures affected growth parameter like plant height, number of branches and number of leaves per plant of Tomato as shown in (Table 1). Significant difference in the vegetative growth of plant was recorded due to application of different combinations of organic manures at all growth stages except 30DAT. The treatment T_6 (Vermicompost + Poultry manure @ 2.5t/ha + 3t/ha) recorded the maximum plant height at different growth stages (30, 60, 90 and 120DAT), i.e. 56.68cm, 94.99cm, 199.44cm and 250.31cm respectively, maximum number of branches per plant (6.00, 8.47, 15.47 and 25.93) at 30, 60, 90 and 120 DAT, respectively and similarly treatment T_6 (Vermicompost + Poultry manure @ 2.5t/ha + 3t/ha) also recorded maximum in number of leaves per plant (6.93, 12.67, 23.53 and 36.07) at 30, 60, 90 and 120 DAT respectively, whereas similar trend was closely followed by treatment T_7 (Vermicompost + Poultry manure @ 1.25t/ha + 4.5t/ha) which differed significantly from each other as well from other treatments. The increase in plant growth in the treatments T_6 might be due to the organic manure applied in the form of Vermicompost in combination with poultry manure might have improved the soil physical and chemical properties and leading to the adequate supply of nutrients to the plants which might have promoted the maximum vegetative growth while the minimum plant growth was recorded with treatment T_0 (control) due to limited availability of nutrients. Similar findings were reported by Patil *et al.* (2004) [6] and Reddy *et al.* (2002) [8] in tomato and Sachan *et al*. (2017) [9] in okra.

Flowering parameters

Experimental findings of different treatments significantly altered with all flowering parameters at all successive stage of growth and flowering. The combination of different organic manures significantly affected flowering parameters of Tomato as shown in (Table 2). The findings of the present study revealed that among the various combinations, treatment T_6 attained maximum vegetative growth and resulted in enhanced flowering by producing more clusters per plant with the application of Vermicompost + Poultry manure @ (2.5t/ha + 3t/ha), which were significantly highest in terms of number of clusters per plant (7.60), number of flowers per cluster (9.01) and number of flowers per plant (56.51); whereas similar trend was closely followed by the treatment T_7 (Vermicompost + Poultry manure @ 1.25t/ha + 4.5t/ha) for these traits, while the constantly lower performance in similar growth and flowering traits at all growth stages was recorded with treatment T_0 (Control). Maximum photosynthetic activity and accumulation of number of flowers in case of T_6 might be due to increased no. of clusters which have produced more flowers due to adequate availability of nutrients during its growth and flowering. The increased flowering per plant might be due to the increased growth attributes. These Results are in close conformity with the finding of Rafi *et al*. (2002) [5]; Poul *et al*. (2004) [7] in tomato and Tripathi *et al.* (2018) [11] in bottle gourd.

Conclusion: Considering the result of the present investigation it is concluded that treatment combination of T_6 (Vermicompost + Poultry manure @ 2.5t/ha + 3t/ha) was found to be the best treatment for better plant growth and flowering. The information obtained from the experiment is helpful to design nutrition program according to plant growth.

Table 1: Effect of organic manures on plant growth of Tomato (*Solanum lycopersicum* L.) under polyhouse condition.

Treatments No.	Treatments Combination	Plant height (cm)				No. of Branches				Number of leaves			
		30 DAT	60 DAT	90 DAT	120 DAT	30 DAT	60 DAT	90 DAT	120 DAT	30 DAT	60 DAT	90 DAT	120 DAT
T_0	Recommended dose of fertilizer (120:60:60 NPK) control	50.61	90.75	186.39	241.04	3.47	6.47	10.41	19.60	5.13	10.00	15.21	28.00
T_1	FYM 100%	51.98	91.07	194.51	244.47	3.87	6.73	13.00	21.07	6.13	9.97	19.80	30.67
T_2	Vermicompost 100%	51.98	91.83	192.50	242.46	4.07	7.20	11.73	21.40	4.93	10.87	18.60	30.80
T_3	Poultry manure 100%	52.51	92.43	195.73	245.54	4.13	7.73	13.07	23.67	5.93	11.37	20.40	32.93
T_4	FYM + Vermicompost (50% + 50%)	53.35	91.60	195.00	244.19	4.53	6.53	13.33	22.93	5.70	9.87	20.27	32.93
T_5	FYM + Vrmicompost (25% + 75%)	53.87	91.03	192.64	244.55	4.40	5.83	12.13	21.13	6.17	9.87	19.47	32.93
T_6	Vermicompost + Poultry manure (50% + 50%)	56.68	94.99	199.44	250.31	6.00	8.47	15.47	25.93	6.93	12.67	23.53	36.07
T_7	Vermicompost + Poultry manure (25% + 75%)	55.45	93.62	198.54	248.38	4.67	7.53	15.33	25.00	6.17	11.13	22.73	35.33
T_8	FYM + Poultry manure (50% + 50%)	52.41	91.47	192.84	242.49	4.67	6.60	12.07	20.13	5.93	9.20	18.20	31.00
T_9	FYM + Poultry manure (25% + 75%)	52.19	92.43	189.45	242.34	3.67	7.27	10.87	20.40	5.47	10.40	17.33	29.27
	F-test	NS	S	S	S	NS	S	S	S	NS	S	S	S
	C.D. at 0.5%	7.70	2.21	4.65	2.56	1.57	1.02	1.87	3.24	1.41	1.54	2.88	4.69
	S.Ed	3.67	1.05	2.22	1.22	0.75	0.49	0.89	1.54	0.67	0.73	1.37	2.23

Table 2: Effect of organic manures on flowering of Tomato (*Solanum lycopersicum* L.) under polyhouse condition.

Treatments No.	Treatments Combination	Number of clusters/plant	Number of flowers/ cluster	Number of flowers/ plant
T_0	Recommended dose of fertilizer (120:60:60 NPK) control	5.67	6.67	33.45
T_1	FYM 100%	6.60	7.89	44.07
T_2	Vermicompost 100%	6.73	7.40	42.82
T_3	Poultry manure 100%	7.00	7.73	46.11
T_4	FYM + Vermicompost (50% + 50%)	6.43	8.10	44.15
T_5	FYM + Vrmicompost (25% + 75%)	6.67	7.18	40.87
T_6	Vermicompost + Poultry manure (50% + 50%)	7.60	9.01	56.51
T_7	Vermicompost + Poultry manure (25% + 75%)	7.37	8.33	52.64
T_8	FYM + Poultry manure (50% + 50%)	6.54	7.95	45.49
T_9	FYM + Poultry manure (25% + 75%)	6.50	7.57	44.46
	F-test	S	S	S
	C.D. at 0.5%	0.91	1.08	6.68
	S.Ed	0.43	0.51	3.18

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