www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(8): 321-324

www.thepharmajournal.com
Received: 08-06-2022
Accepted: 17-07-2022

Gulshan Pandey
Department of Vegetable Science, IGKV, Raipur, Chhattisgarh, India

Amit Dixit
College of Horticulture and Research Station, Sankra, Durg, (IGKV), Chhattisgarh, India

Pappu Lal Bairwa
College of Horticulture, Dhamtari, IGKV, Raipur, Chhattisgarh, India

RK Mahobia
College of Agriculture and Research Station, Kurud, Chhattisgarh, India

Corresponding Author:
Gulshan Pandey
Department of Vegetable Science, IGKV, Raipur, Chhattisgarh, India

Effect of foliar application of micronutrients and gibberellic acid on growth, yield and economics of Tomato (*Solanum lycopersicum* L.) cv. PANT T-3

Gulshan Pandey, Amit Dixit, Pappu Lal Bairwa and RK Mahobia

Abstract
A field experiment was conducted to study the effect of foliar application of micronutrients and gibberellic acid on growth, yield and economics of tomato (*Solanum lycopersicum* L.) cv. PANT T-3 at the farm of College of Agriculture and Research Station, Kurud (C.G.) during *rabi* season of 2021-22. The experiment was carried out under randomized block design (RBD) with three replicates and nine treatments. Among all the treatments data clearly showed that the maximum growth, yield and economics *i.e.,* plant height (116.45 cm), number of branches per plant (5.33), stem girth (3.33 cm), number of fruits per plant (39.87), fruit diameter (4.83 cm), fruit length (4.44 cm), average fruit weight (53.53 g), yield per plant (2.11 kg), yield per plot (25.36 kg), yield per hectare (782.71 q) and highest benefit cost ratio (4.24) was found in T_5 as compared to T_9 (Control). Therefore, combined effect of Boron @ 100ppm, Copper Sulphate @ 100ppm, Zinc Sulphate @ 100ppm and GA_3 @ 75ppm is suitable for higher growth and yield in tomato.

Keywords: Micronutrients, gibberellic acid, growth, yield parameters and Tomato

Introduction
Tomato (*Solanum lycopersicum* L.) is also called Poor man's Orange, Love of Apple, Vilayati Baigan, Wolf Apple. The tomato is an annual herbaceous plant belonging to the family Solanaceae and originated in South America having chromosome number 2n=24. It is a tropical day neutral crop with significant self-pollination due to homomorphism and chasmogamy. Tomato fruits can be consumed raw or cooked.Single tomato can offer 40% of the daily Vitamin C requirement which is a natural anti-oxidant. Tomatoes play a major role in blood clotting because they are rich in Vitamin-K. In India, all vegetables are grown on an area of 10,352.88 thousand hectare with an annual production of 1,91,769.11 thousand MT. Tomato is grown on an area of 812 thousand hectares with an annual production of 20,573 thousand MT and productivity 25.33 tons/ha (Anon, 2020) [2]. Boron is an essential micronutrient that plays a role in carbohydrate metabolism, cell division, cell wall formation, flowering, and fruit set. Zinc plays an important role in the growth and development as well as sexual fertilization, carbohydrates and protein metabolism of plants (Imtiaz *et al*., 2003; Vasconcelos *et al*., 2011) [5, 13]. Copper is a component of several enzymes as well as vitamin A. Copper is a vital micronutrient for plant growth and development and is detrimental to photosynthetic membranes (Maksymiec, 1997) [7]. GA_3 promotes shoot growth by increasing the length of internodes by accelerating cell elongation and division in the subapical meristematic zone.

Materials and Methods
The research study was conducted at College of Agriculture and Research Station, (IGKV), Kurud (C.G.) during *rabi* season of 2021-22. After 30 days of sowing seedlings of uniform size, age, free from insect pest and disease infestation were transplanted in sowing plots with row to row and plant to plant distance of 60 and 45 cm apart, respectively. Farm yard manure @ 20 t ha^{-1} was applied during the final ploughing and well mixed in the soil. The recommended fertilizer dose of 125 kg N, 75 kg P_2O_5 and 60 kg K_2O per ha was applied in the form of the urea, SSP and MoP, respectively.

The experiment was carried out under randomized block design (RBD) with three replicates and nine treatments *viz*., T_1 (Boron @100ppm), T_2 (Copper Sulphate @ 100ppm), T_3 (Zinc Sulphate @ 100ppm), T_4 (GA_3 @ 75ppm), T_5 (Boron @ 100ppm + Copper Sulphate @ 100ppm + Zinc Sulphate @ 100ppm + GA_3 @ 75ppm), T_6 (Boron @ 100ppm + Copper Sulphate @ 100ppm), T_7 (Boron @ 100ppm + Zinc Sulphate @ 100ppm), T_8 (Boron @ 100ppm + GA_3 @ 75ppm) and T_9 (Control).

During the growth parameters and yield parameters encompassed in the study were plant height (cm), number of branches plant^{-1}, stem girth (cm), number of fruits plant^{-1}, fruit diameter (cm), fruit length (cm), average fruit weight (g), yield plant^{-1}(kg), yieldplot^{-1} (kg) and yield q ha^{-1}. The data collected from five randomly selected plants for above said parameters were subjected to analysis of variance technique (ANOVA) and least significance difference test was applied to separate different treatment means.

Results and Discussion

The growth parameters and yield attributing of tomato increased significantly with the different micronutrients (Table 1, 2 and 3).

Significantly maximum plant height 116.45 cm was recorded in T_5 (Boron @ 100ppm + Copper Sulphate @ 100ppm + Zinc Sulphate @ 100ppm + GA_3 @ 75ppm), followed by 109.32 cm in T_8 (Boron @ 100ppm + GA_3 @ 75ppm) and 104.56 cm in T_7 (Boron @ 100ppm + Zinc Sulphate @ 100ppm). Whereas, minimum plant height 80.18 cm was recorded in T_9 (Control). In earlier studies, Sivaiah *et al*. (2012) found that combined application of micronutrients produced the maximum plant height and Jakhar *et al.* (2018) [6] reported that plant sprayed with GA_3 found superior in all growth parameters such as plant height.

Significantly maximum number of branches 5.33 was found in T_5 (Boron @ 100ppm + Copper Sulphate @ 100ppm + Zinc Sulphate @ 100ppm + GA_3 @ 75ppm) followed by 5.27 in T_8 (Boron @ 100ppm + GA_3 @ 75ppm) and 5.07 in T_7 (Boron @ 100ppm + Zinc Sulphate @ 100ppm). While, lowest number of branches 3.60 per plant was observed in T_9 (Control). In earlier studies, Jakhar *et al.* (2018) [6] reported the maximum number of branches per plant was found in GA_3 sprayed plants and Saravaiya *et al.* (2014) [9] found the similar results by foliar application of the mixture of all micronutrients.

The spraying of different micronutrients and gibberellic acid showed singnificantly positive response in plant girth. Maximum plant girth 3.33 cm was observed in T_5 (Boron @ 100ppm + Copper Sulphate @ 100ppm + Zinc Sulphate @ 100ppm + GA_3 @ 75ppm) which found to be superior than all other treatments followed by 3.23 cm in T_8 (Boron @ 100ppm + GA_3 @ 75ppm) and 3.19 cm in T_7 (Boron @ 100ppm + Zinc Sulphate @ 100ppm). Minimum plant girth 2.25 cm was recorded in T_9 (Control). In earlier studies Dixit *et al.* (2018) [4] reported that spray of mixture of micronutrients resulted in maximum plant girth.

The result revealed that the minimum days to first flowering 29.67 was recorded in T_5 (Boron @ 100ppm + Copper Sulphate @ 100ppm + Zinc Sulphate @ 100ppm + GA_3 @ 75ppm), which was significantly superior over other treatments, followed by 30.33 days in T_8 (Boron @ 100ppm + GA_3 @ 75ppm) and 31.00 days in T_4 (GA_3 @ 75ppm). While, maximum number of days to first flowering 35.67 days was observed in T_9 (Control).

Significantly earliest 50% flowering 33.67 days has been observed from treatment T_5 (Boron @ 100ppm + Copper Sulphate @ 100ppm + Zinc Sulphate @ 100ppm + GA_3 @ 75ppm), followed by 34.00 days in T_8 (Boron @ 100ppm + GA_3 @ 75ppm) and 34.67 days in T_4 (GA_3 @ 75ppm).While, maximum number of days to 50% flowering 39.67 days was shown by T_9 (Control). Due to the rapid increase in the physiological process, there may be a greater accumulation of carbohydrates, owing to greater photosynthesis which caused early flowering reported by Wittwer *et al.* (1957) [14].

Significantly minimum days to first fruiting 36.67 days was recorded in T_5 (Boron @ 100ppm + Copper Sulphate @ 100ppm + Zinc Sulphate @ 100ppm + GA_3 @ 75ppm), which was significantly superior over other treatments followed by 37.33 days in T_8 (Boron @ 100ppm + GA_3 @ 75ppm) and 38.33 days in T_4 (GA_3 @ 75ppm). While maximum days to first fruiting 44.67 days were observed in T_9 (Control). Singh *et al.* (2021) [10] also reported that application of GA3 @ 100ppm resulted in early days to first fruit set.

Significantly minimum days to maturity 60.67 days was recorded in T_5 (Boron @ 100ppm + Copper Sulphate @ 100ppm + Zinc Sulphate @ 100ppm + GA_3 @ 75ppm), followed by 61.67 days in T_8 (Boron @ 100ppm + GA_3 @ 75ppm) and 62.33 days in T_7 (Boron @ 100ppm + Zinc Sulphate @ 100ppm).Whereas, maximum number of days to maturity 73.33 days recorded in T_9 (Control). Similar results for micronutrients application were found by Naz *et al*. (2012) [8] and Ali *et al.* (2013) [1] in tomato.

The data showed significantly maximum number of fruits 39.87 per plant was found in T_5 (Boron @ 100ppm + Copper Sulphate @ 100ppm + Zinc Sulphate @ 100ppm + GA_3 @ 75ppm) was significantly superior over other treatments followed by 38.80 in T_8 (Boron @ 100ppm + GA_3 @ 75ppm) and 37.53 in T_4 (GA_3 @ 75ppm). The lowest number of fruits 28.27 per plant was observed in T_9 (Control). Uddain *et al.* (2009) [12] in tomato found that application of gibberellic acid resulted in maximum number of fruits plant^{-1}

Among all the treatments, maximum fruit length 4.44 cm was observed in the treatment T_5 (Boron @ 100ppm + Copper Sulphate @ 100ppm + Zinc Sulphate @ 100ppm + GA_3 @ 75ppm), which was significantly superior over other treatments followed by 4.27 cm T_8 (Boron @ 100ppm + GA_3 @ 75ppm) and 4.30 cm T_7 (Boron @ 100ppm + Zinc Sulphate @ 100ppm). While, the minimum fruit length 3.34 cm was recorded in the T_9 (Control). Saravaiya *et al.* (2014) [9] found that application of application of the mxture of all micronutrients resulted in maximum fruit length similar result was found by Desai *et al.* (2012) [3] by applying gibberellic acid.

Among all the treatments, maximum fruit diameter 4.83 cm was found in T_5 (Boron @ 100ppm + Copper Sulphate @ 100ppm + Zinc Sulphate @ 100ppm + GA_3 @ 75ppm), which was significantly superior over other treatments followed by 4.76 cm in T_8 (Boron @ 100ppm + GA_3 @ 75ppm) and 4.72 cm in T_4 (GA_3 @ 75ppm). Whereas, minimum fruit diameter 3.64 cm was recorded in the treatment T_9 (Control). Desai *et al.* (2012) [3] in tomato found that gibberellic acid application resulted in maximum fruit diameter and similarly Dixit *et al.* (2018) [4] also found the similar result by application of mixture of micronutrients.

The maximum average fruit weight 53.53 g was recorded in treatment T_5 (Boron @ 100ppm + Copper Sulphate @

100ppm + Zinc Sulphate @ 100ppm + GA_3 @ 75ppm), which was significantly superior over other treatments followed by 52.27 g in T_8-Boron @ 100ppm + GA_3 @ 75ppm) and 51.37 g in T_4 (GA_3 @ 75ppm). Whereas, minimum fruit weight 39.87 g was observed in the treatment T_9 (Control). Saravaiya *et al.* (2014) [9] and Dixit *et al.* (2018) [4] reported that the application of mixture of micronutrients increased the average fruit weight similarly Singh *et al.* (2021) [10] also reported that application of gibberellic acid increased the fruit weight.

Maximum fruit yield 2.11 kg per plant was recorded in the treatment T_5 (Boron @ 100ppm + Copper Sulphate @ 100ppm + Zinc Sulphate @ 100ppm + GA_3 @ 75ppm), which was significantly superior over the other treatments followed by 2.01 kg T_8 (Boron @ 100ppm + GA_3 @ 75ppm) and 1.92 kg T_4 (GA_3 @ 75ppm). Whereas, the minimum fruit yield 1.17 kg per plant was found in treatment T_9 (Control). Sivaiah *et al.* (2013) [11] and Saravaiya *et al.* (2014) [9] reported that mixture of micronutrients increased the fruit yield similarly application of gibberellic acid increased the fruit yield reported by Singh *et al.* (2021) [10].

Maximum fruit yield 25.36 kg per plot was recorded in the treatment T_5 (Boron @ 100ppm + Copper Sulphate @ 100ppm + Zinc Sulphate @ 100ppm + GA_3 @ 75ppm), which was significantly superior over the other treatments followed by 24.12 kg in T_8 (Boron @ 100ppm + GA_3 @ 75ppm) and 23.05 kg T_4 (GA_3 @ 75ppm). Whereas, the lowest fruit yield 14.04 kg per plot was found in treatment T_9 (Control).

Maximum fruit yield 782 q per hectare was recorded in the treatment T_5 (Boron @ 100ppm + Copper Sulphate @ 100ppm + Zinc Sulphate @ 100ppm + GA_3 @ 75ppm), which was significantly superior over the other treatments followed by 744.44 q in T_8 (Boron @ 100ppm + GA_3 @ 75ppm) and 711.31 q T_4 (GA_3 @ 75ppm). Whereas, the lowest fruit yield 433.33 q per plot was found in treatment T_9 (Control).

The total cost of cultivation Rs 1,40,308 was common for all the treatments. Maximum gross income of Rs 7,82,710 was obtained with the treatment T_5 (Boron @ 100ppm + Copper Sulphate @ 100ppm + Zinc Sulphate @ 100ppm + GA_3 @ 75ppm) followed by Rs 7,44,440 in T_8 (Boron @ 100ppm + GA_3 @ 75ppm) and Rs 7,11,310 in T_4 (GA_3 @ 75ppm). The maximum net return of Rs 6,33,513 was found with T_5 (Boron @ 100ppm + Copper Sulphate @ 100ppm + Zinc Sulphate @ 100ppm + GA_3 @ 75ppm) followed by Rs 6,00,025 in T_8 (Boron @ 100ppm + GA_3 @ 75ppm) and Rs 5,69,315 in T_4 (GA_3 @ 75ppm). Maximum benefit: cost ratio 4.24 obtained with T_5 (Boron @ 100ppm + Copper Sulphate @ 100ppm + Zinc Sulphate @ 100ppm + GA_3 @ 75ppm) followed by 4.15 in T_8 (Boron @ 100ppm + GA_3 @ 75ppm) and 4.01 in T_4 (GA_3 @ 75ppm). Whereas, minimum benefit cost ratio 2.08 found in T_9 (Control).

Table 1: Effect of micronutrients and gibberellic acid on mean performance of growth traits of tomato

Treatment	Plant height (cm)	Number of branches	Plant girth (cm)	Days to first flowering	Days to 50% flowering	Days to first fruiting	Days to maturity
T_1	94.49	4.53	2.72	33.33	37.00	41.33	66.00
T_2	90.66	4.13	2.46	34.33	38.33	42.33	67.33
T_3	92.36	4.27	2.77	33.67	37.67	41.67	66.67
T_4	101.12	4.67	2.84	31.00	35	38.33	63.67
T_5	116.45	5.33	3.33	29.67	33.67	36.67	60.33
T_6	98.01	4.33	3.13	32.67	36.67	40.67	64.33
T_7	104.56	5.07	3.19	32.00	35.67	39.67	62.33
T_8	109.32	5.27	3.23	30.33	34.00	37.33	61.67
T_9	80.18	3.6	2.25	35.67	39.67	44.67	73.33
Mean	98.57	4.57	2.88	32.51	36.41	40.29	65.07
CV (%)	8.13	10.16	7.11	6.44	5.86	6.83	6.38
CD(0.05)	13.88	0.8	0.35	3.62	3.69	4.76	7.19
SE(m±)	4.62	0.26	0.11	1.21	1.23	1.58	2.39

Table 2: Effect of micronutrients and gibberellic acid on mean performance of yield attributing traits and yield of tomato

Treatment	Number of fruits per plant	Fruit Length (cm)	Fruit Diameter (cm)	Average fruit weight (g)	Yield per plant (kg)	Yield per plot (kg)	Yield per hectare (q)
T_1	33.07	3.75	4.28	47.97	1.53	18.36	566.66
T_2	32.13	3.62	4.14	45.23	1.43	17.12	528.39
T_3	32.73	3.66	4.22	46.2	1.48	17.72	546.91
T_4	37.53	4.16	4.72	51.37	1.92	23.05	711.31
T_5	39.87	4.44	4.83	53.53	2.11	25.36	782.71
T_6	35.4	4.07	4.48	46.37	1.64	19.72	608.64
T_7	35.93	4.3	4.53	47.97	1.71	20.52	633.33
T_8	38.8	4.27	4.76	52.27	2.01	24.12	744.44
T_9	28.27	3.34	3.64	39.83	1.17	14.04	433.33
Mean	34.85	3.95	4.4	47.85	1.66	20.01	617.31
CV (%)	8.26	7.21	7.1	8.36	11.09	11.15	11.15
CD (P=0.05)	4.98	0.49	0.54	6.92	0.32	3.86	119.13
SE(m±)	1.66	0.16	0.18	2.31	0.11	1.28	39.73

Table 3: Effect of micronutrients and gibberellic acid on mean performance of economics of tomato

Tr. No.	Cost of Cultivation (Rs/ha)	Gross Monetary Returns (Rs/ha)	Net Monetary Returns (Rs/ha)	B:C Ratio
T_1	142728	566660	423932	2.97
T_2	142790	528390	385600	2.70
T_3	142608	546910	404302	2.83
T_4	141995	711310	569315	4.01
T_5	149197	782710	633513	4.24
T_6	145210	608640	463430	3.19
T_7	145028	633330	488302	3.36
T_8	144415	744440	600025	4.15
T_9	140308	433330	293022	2.08

Conclusion

The growth, yield attributes and yield parameters *i.e.*,plant height (cm), number of branches per plant, stem girth (cm), number of fruits per plant, fruit diameter (cm), fruit length (cm), average fruit weight (g), yield per plant (kg), yield per plot (kg), yield per hectare (q)and benefit cost ratio were significantly superior in T_5 (Boron @ 100ppm + Copper Sulphate @ 100ppm + Zinc Sulphate @ 100ppm + GA_3 @ 75ppm). On the basis of above findings, T_5 found to be the best treatment among all the treatments in first position and T_8 stand in second order of preference. Therefore, it may be concluded that treatments T_5 may be preferred for higher growth and yield in tomato.

References

1. Ali S, Javed HU, Rehnam RNU, Sabir IA, Naeem MS, Siddiqui MZ, *et al*. Foliar application of some macro and micro nutrients improves tomato growth, flowering and yield. International Journal of Biosciences. 2013;3(10):280-287.
2. Anonymous. Indian Horticulture Database. National Horticulture Board, Ministry of Agriculture and Farmer's Welfare, Government of India, 2020.
3. Desai SS, Chovatia RS, Singh V. Effect of different plant growth regulators and micronutrients on fruit characters and yield of tomato cv. Gujrat Tomato-3. The Asian Journal of Horticulture. 2012;7(2):546-549.
4. Dixit A, Sharma TK D, Bairwa PL. Effect of foliar application of some macro and micronutrients on growth and yield of tomato (*Solanum lycopersicum* L.) cv. ArkaRakshak. International Journal of Current Microbiology and Applied Sciences. 2018;6:197-203.
5. Imtiaz M, Alloway BJ, Shah KH, Siddiqui SH, Memon MY, Aslam M, *et al*. Zinc nutrition of Wheat I: Growth and Zinc Uptake. Asian Journal of Plant Sciences. 2003;2(2):152-155.
6. Jakhar D, Thaneshwari, Nain S, Jakhar N. Effect of Plant Growth Regulator on Growth, Yield & Quality of Tomato (*Solanum lycopericum*) Cultivar 'Shivaji' under Punjab Condition. International Journal of Current Microbiology and Applied Sciences. 2018;7:2319-7706.
7. Maksymiec W. Effect of copper on cellular processes in higher plants. Photosynthetica. 1998;34:321-342.
8. Naz RMM, Muhammad S, Hamid A, Bibi F., Effect of boron on flowering and fruiting of tomato. Sarhad J Agric. 2012;28(1):37-40.
9. Saravaiya SN, Wakchaure SS, Jadhav PB, Tekale GS, Patil NB, Dekhane SS, *et al*. Influence of foliar application of micronutrients on Tomato (*Lycopersicon esculentum* Mill.) cv. Gujarat Tomato 2. International Journal of Development Research. 2014;4(8):1539-1542.
10. Singh VP, Singh DP, Lal B, Yadav MK, Satyendra K. Effect of micronutrients and PGR on growth and yield of tomato (*Solanum lycopersicum* L.) variety Azad-T_6. International Journal of Chemical Studies. 2021;9(2):467-470.
11. Sivaiah, Naga K, Swain SK, Verma SV, Raju B. Effect of foliar application of micronutrients on growth parameters in tomato (*Lycopersicon esculentum*Mill.). Discourse Journal of Agriculture Food Sciences. 2013;1(10):146-151.
12. Uddain J, Hossain AKM, Mostafa MG, Rahman MJ. Effect of different plant growth regulators on growth and yield of tomato. International Journal of Sustainable Agriculture. 2009;1(3):58-63.
13. Vasconcelos ACFD, Nascimento CWA, Filho FFDC. Distribution of zinc in maize plants as a function of soil and foliar Zn supply. International Research Journal of Agricultural Science and Soil Science. 2011;1(1):001-005.
14. Wittwer SH, Bukovak MJ, Sell HM, Weller LE. Some effects of gibberellin on flowering and fruit setting. Pl. Physiol. 1957;32:39-41.