

Effect of Plant Growth Regulators on Cherry Tomato (*Solanum lycopersicum var. cerasiforme*)

ABSTRACT

A cherry tomato is a small-sized tomato variety known for its round shape and sweet flavor. Therefore, at the Department of Horticulture at Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj, Uttar Pradesh, an investigation titled "Effect of Plant Growth Regulators on Cherry Tomato" was conducted during the Rabi-2022-23 season to assess the impact of plant growth regulators on the growth, quality, and yield of Pusa Cherry 1 tomatoes, as well as analyze the economic aspects of different treatments. Ten treatments were employed, including control with different concentrations of growth regulators (GA_3 and Auxin) and Kinetin. The study found that using plant growth regulators had a significantly positive effect on cherry tomatoes for all traits. Among the treatments tested, $T_3(GA_3 @ 75 \text{ ppm})$ showed the most favourable results in terms of plant height, number of primary branches, early flowering and maturing. T_3 also demonstrated superior performance in terms of fruit weight, the maximum number of fruits per plant, and yield per plant.

Keywords: Growth, Yield, Cherry tomato, Auxin, Kinetin, GA_3 .

INTRODUCTION

“Cherry Tomato, botanically known as *Solanum lycopersicum var. cerasiforme* is one of the most popular and widely grown vegetable crops throughout the world and is treated as “protective food” universally. Cherry Tomato is known as the poor man’s apple (orange) in India & love apples in England. It is used as soup, salad, pickles, ketchup, puree, sauces, tomato paste, tomato juice and other products. The pulp and juice of tomato fruit are digestible and a mild aperient, a promoter of gastric secretion and a blood purifier. Tomatoes are a horticulture crop belonging to the family Solanaceae bearing chromosome number $2n=2X=24$ ” (Fedorov, 1969). “It originated in South America” (Vavilov, 1935). “The tomato plants typically grow to 1–3 meters (3–10 ft) in height and have a weak stem that often sprawls over the ground and vines over other plants. Flowers are generally borne in clusters of 4 to 8 but small fruited types may have 30 to 50 flowers per cluster. Tomato plays a major role in human nutrition, fruit contains 93.1% water, 1.9% protein, 0.3 g fat, 0.7% fibre, 3.6% carbohydrates, 23 calorie, 320 IU vitamin A., 0.07 mg vitamin B1, 0.01 mg vitamin B2, 31 mg vitamin C, 20 mg calcium, 36 mg phosphorus and 0.8 mg iron. Tomato has valuable vitamins and cholesterol. Approximately 20–50 mg of lycopene per 100g of fruit weight can be obtained from tomatoes. Tomato is a warm-season crop. The best fruit colour and quality are obtained at a temperature range of 21–24°C. Tomato is one of the most versatile crops in the world because of its fast and wide climate adaption and it is universally treated as protective food. Tomato contributes to a healthy, well-balanced diet. They are rich in minerals, vitamins, essential amino acids, sugars, and dietary fibres, and it has many other uses tomato seed contain 24% of oil and is used as salad oil and in the manufacture of margarine”. (Prasad et. Al., 2022) India is the second-largest producer of tomatoes in the world, accounting for 30.26% of global production, with China in first place and Turkey in third. In the year 2021-22, India produced 36.29 million tonnes of tomatoes on 48.72 thousand hectares of land, with Madhya Pradesh ranking first in both area and production. Other major tomato-producing states in India include Bihar, Karnataka, Uttar Pradesh, Orissa, Andhra Pradesh, Maharashtra, and West Bengal. Plant growth regulators (PGRs) are crucial for the growth and development of tomato plants. They promote cell

division, elongation, and differentiation, leading to better plant growth, flowering, fruiting, and seed formation. PGRs can also enhance nutrient uptake efficiency, increase resistance to biotic and abiotic stresses, and improve crop quality and yield. In tomato cultivation, PGRs like gibberellic acid (GA₃) and salicylic acid can improve plant vigour and health, synchronize maturity, promote fruit set, and increase marketable yield, thereby increasing profitability. The use of PGRs is a valuable tool for growers to maximize crop potential and meet consumer demand.

MATERIALAND METHODS

The present investigation was done to understand the effect of plant growth regulators (PGRs) at different doses combination on growth, yield and quality of cherry tomato variety Pusa Cherry 1. The experiment was carried out at Horticultural Research Farm (HRF), Department of Horticulture, Naini Agricultural Institute SHUATS, Prayagraj, U.P., during the *Rabiseason* of 2022-23. The experiment was carried out with ten treatments each replicated thrice in randomized block design (RBD). The data were statistically analysed by the method suggested by Fisher and Yates, 1963. The treatments comprised of T₀(Control), T₁(GA₃@ 25 ppm), T₂(GA₃@ 50 ppm), T₃(GA₃@ 75ppm), T₄(Auxin@ 25 ppm), T₅(Auxin@ 50ppm), T₆(Auxin@ 75 ppm), T₇(Kinetin@ 25 ppm), T₈(Kinetin@ 50 ppm), and T₉(Kinetin@ 75 ppm).

Table 1 Performance of different treatments of PGRs on growth and yield parameters studied for Cherry tomato.

Treatment details	Plant height (at harvest) (cm)	Number of primary Branches per plant	Days to first flowering	Days to first fruit setting	Days to first Fruit picking	Number of flower clusters per plant	Number of fruits per cluster	No of fruits/plant	Weight of single fruit (g)	Fruit yield per plant (Kg/plant)	TSS [°Brix]	Ascorbic acid content (mg/100g)	Acidity (%)
T ₀ (Control)	96.20	7.73	47.33	63.33	75.67	9.27	18.08	167.63	12.98	2.21	3.80	9.42	0.28
T ₁ (GA ₃ @ 25 ppm)	110.33	11.60	38.33	53.67	66.67	11.87	19.80	235.13	15.00	3.25	4.68	12.46	1.31
T ₂ (GA ₃ @ 50 ppm)	105.31	10.40	39.33	55.33	67.67	12.52	19.12	239.81	23.54	5.45	4.44	13.39	0.59
T ₃ (GA ₃ @ 75ppm)	117.02	13.40	35.00	51.00	63.33	12.53	22.71	284.72	31.15	8.10	6.24	14.50	1.55
T ₄ (Auxin@ 25 ppm)	108.95	8.87	46.00	61.67	74.33	10.73	19.18	205.75	16.68	3.30	6.09	14.15	1.03
T ₅ (Auxin@ 50ppm)	115.94	11.40	44.33	60.00	72.33	10.80	20.09	216.94	13.20	2.65	6.14	11.91	0.32
T ₆ (Auxin@ 75 ppm)	116.12	9.87	40.33	56.00	68.33	12.00	18.47	221.64	29.62	6.45	4.95	10.52	1.20
T ₇ (Kinetin@ 25 ppm)	115.48	8.27	36.00	51.67	64.33	10.93	21.94	239.87	15.67	3.76	5.58	10.91	0.64
T ₈ (Kinetin@ 50 ppm)	113.38	9.27	42.33	58.00	71.00	11.27	19.20	216.28	24.59	5.32	4.25	11.53	0.54
T ₉ (Kinetin@ 75 ppm)	108.65	12.27	37.67	53.67	66.00	11.07	18.97	210.16	26.34	5.53	4.46	11.80	0.70
'F' test	S	S	S	S	S	S	S	S	S	S	S	S	S
C.D. at 5%	0.13	1.63	0.79	0.74	0.58	1.60	5.07	5.39	1.28	5.42	6.69	0.82	4.09
C.V.	0.25	9.13	1.13	0.72	0.69	0.31	1.73	2.08	0.46	0.45	0.59	0.17	0.06

RESULTS AND DISCUSSION

Growth Parameters

Plant height (cm)

The maximum plant height (117.02 cm) at harvest was observed with treatment T₃ (GA₃ @ 75 ppm) followed by T₆ (Auxin @ 75 ppm) with 116.12 cm. “Minimum plant height (96.20 cm) was observed in T₀ (Control), while the remaining treatments were moderate in their growth habit. The application of plant growth regulators (PGRs) might have improved the soil’s physical and chemical properties and lead to the adequate supply of nutrients to the plants which might have promoted the maximum vegetative growth while the minimum plant growth was due to the non-availability of nutrients”. Similar findings were reported by Farooq *et al.* (2018); Kumar *et al.* (2018) and Alamet *al.* (2019) in tomatoes.

Number of primary branches per plant

“The number of branches per plant was influenced by different treatments at all successive stage of growth. There was a significant difference between the treatments at among the treatments applied. It was also found that T₃ (GA₃@ 75ppm) with maximum value i.e., 13.40 branches per plant followed by T₉ (Kinetin @ 75 ppm)with 12.27 branches per plant whereas the minimum branches were observed in treatment T₀ (Control) with 7.73. It was noticed that the number of branches per plant increased with increasing plant height successively with the increasing levels of micronutrients. The combination of plant growth regulators (PGRs) also recorded maximum plant height and the number of branches which helped the plants in better photosynthesis to attain vigour”. The findings of the present investigation are in reports of Farooq *et al.* (2018); Kumar *et al.* (2018) and Alamet *al.* (2019) in tomatoes.

Earliness parameter

Days to first flowering, days first fruit setting and days to first fruit picking

Among the application of plant growth regulators (PGRs) the minimum days to first flowering were seen in T₃ (GA₃@ 75ppm) with 35.00 days, followed by T₇ (Kinetin @ 25ppm)with 36.00 days whereas maximum days to first flowering 47.33 days were recorded in T₀ (Control). Among the application of plant growth regulators (PGRs) the minimum days to first fruit setting were seen in T₃ (GA₃@ 75ppm) with 51.00 days, followed by T₇ (Kinetin @ 25ppm)with 51.67 days whereas maximum days to first fruit setting 63.33 days were recorded in T₀ (Control). Among the application of plant growth regulators (PGRs) the minimum days to first fruit picking were seen in T₃ (GA₃@ 75ppm) with 63.33 days, followed by T₇ (Kinetin @ 25ppm)with 75.67 days whereas maximum days to first fruit picking 75.67 days were recorded in T₀ (Control). “Integration of different nutrient management favoured vigorous growth and synthesized more of these hormones in plants, which might have helped to the translocation as well as more quantity of available phosphorus through the xylem vessels and their accumulation in the axillary buds that would have favoured the plant to enter the reproductive phase”. Similar results have also been reported by Farooq *et al.* (2018); Islam *et al.* (2018), Alamet *al.* (2019) and Mishra *et al.*, (2019) in tomato.

Yield Parameter

Number of flower clusters per plant, Number of fruits per cluster, Number of fruits per plant, fruitweight (g) and fruit diameter (cm)

Among the application of plant growth regulators (PGRs) the maximum number of flower clusters per plant was seen in T₃ (GA₃@ 75ppm) with 12.53 clusters followed by T₂ (GA₃@ 50 ppm) with 12.52 flowers whereas a minimum number of flower clusters per plant 9.27 flowers was recorded in T₀ (Control). Among the application of plant growth regulators (PGRs) the maximum number of fruit set per plant was seen in T₃ (GA₃@ 75ppm) with 22.71 flowers followed by T₁ (GA₃@ 25ppm) with 18.08 flowers whereas minimum number of fruit set per plant 21.94 flowers was recorded in T₀ (Control). The maximum number of fruits per plants 284.72 fruits was recorded in treatment T₃ (GA₃@ 75ppm) followed by T₇ (Kinetin@ 25 ppm) i.e., 239.87 fruits and the lowest number of fruits per plant 167.63 were observed in T₀ (Control). The maximum average weight of fruit 31.15 g was recorded in treatment T₃ (GA₃ @ 75ppm) followed by T₆ (Auxin @ 75 ppm) i.e., 29.62 g and the lowest weight of fruit 12.98 g were observed in T₀ (Control). The maximum average yield per plant of 8.10 kg/plant was recorded in treatment T₃ (GA₃ @ 75ppm) followed by T₆ (Auxin @ 75 ppm) i.e., 6.45 kg/plant and the lowest yield per plant was 2.21 kg/plant were observed in T₀ (Control). “The Maximum number of fruits per plant increase of T₃ (GA₃@ 75 ppm) might be due to the increased number of flowers which might have formed into fruits due to adequate availability of major and minor nutrients during its growth and development. Integration of nutrients favoured vigorous growth and synthesized more of these hormones in plants, which might have helped the translocation as well as more quantity of available boron through the xylem vessels and their accumulation in the axillary buds that would have favoured the plant to enter the fruiting phase”. Similar results have also been reported by Ahmadi and Majidi (2016); Farooq *et al.* (2018); Kumar *et al.*, (2018); Islam *et al.* (2018), Ansary *et al.*, (2019); Alamet *et al.* (2019) and Mishra *et al.*, (2019) in tomato.

Quality parameter

TSS [°Brix], Ascorbic acid content (mg/100g) and acidity (%)

The maximum TSS of 6.24 °Brix was recorded in treatment T₃ (GA₃ @ 75ppm) followed by T₅ (Auxin @ 50 ppm) i.e., 6.14 °Brix and the lowest TSS of 3.80 °Brix was observed in T₀ (Control). The maximum Acidity of 14.50 mg/100g was recorded in treatment T₃ (GA₃ @ 75ppm) followed by T₄ (Auxin@ 25 ppm) i.e., 14.15 mg/100g and the lowest acidity of 9.42 mg/100g was observed in T₀ (Control). The maximum Acidity of 1.55% was recorded in treatment T₃ (GA₃ @ 75ppm) followed by T₁ (GA₃ @ 25 ppm) i.e., 1.31% and the lowest acidity 0.28% was observed in T₀ (Control). PGRs play an important role in improving productivity and the quality of fruit. Added dose of nutrients increased the vigour of plants, assimilating area, and size of fruit, thereby resulting in higher T.S.S. These results are in close conformity with the findings of Ahmadi and Majidi (2016); Farooq *et al.* (2018); Kumar *et al.*, (2018); Islam *et al.* (2018), Ansary *et al.*, (2019); Alamet *et al.* (2019) and Mishra *et al.*, (2019) in tomato.

Summary and Conclusion

The findings of current study suggested that the use of plant growth regulators had a significant positive impact on the germination, growth, and development of tomatoes. Among the treatments tested, T₃(GA₃ @ 75 ppm) showed the most favourable results in terms of plant growth and fruit yield and quality.

References

Alam, B., Salman, K. and Mehboob, J. (2019). "Indole-3-acetic acid rescues plant growth and yield of salinity stressed tomato (*Lycopersicon esculentum* L.)." *Gesunde Pflanzen* 72(1): 87-95.

Ahmadi, R., & Majidi, M. M. (2016). Effect of plant growth regulators on the growth and yield of tomato. *International Journal of Horticultural Science and Technology*. 3(2), 187-195.

Ansary, S. H. M., Rahman, M. M., Uddin, M. K., Rahman, M. L., & Rana, M. S. (2019). Effect of different plant growth regulators on the growth and yield of tomato. *American Journal of Agriculture and Forestry*. 7(5), 147-154.

Directorate of Economics and Statistics, (2020-21) Ministry of Agriculture & Farmers Welfare (DAC & FW), Government of India, 2020-21).

Farooq, S., Azam, F., & Akhtar, J. (2018). Effect of plant growth regulators on growth and yield of tomato under drought stress. *Pakistan Journal of Agricultural Sciences*. 55(4), 827-834.

Fedorov, A. A. (1969). Chromosome Number of Flowering Plants. *Academy of Sciences of USSR. Moscow*. 926 pp.

Fisher, R. A. and Yates, F. (1963). Statistical Tables for Biological, Agricultural and Medical Research. *Oliver and Boyd, London*: 143 p.

Islam, A., Amin, M. R., Sultana, S., & Uddin, M. K. (2018). Effect of different plant growth regulators on growth and yield of tomato. *Journal of Bioscience and Agriculture Research*. 17(2), 1694-1701.

Kumar, R., Singh, R., & Dwivedi, P. (2018). Influence of plant growth regulators on growth, yield and quality of tomato. *International Journal of Current Microbiology and Applied Sciences*. 7(7), 1486-1495.

Mishra, S. S., Sharma, S., & Singh, A. K. (2019). Effect of plant growth regulators on growth, yield and quality of tomato under greenhouse conditions. *International Journal of Chemical Studies*. 7(3), 1300-1303.

National Horticultural Board, Ministry of Agriculture & Farmers Welfare (DAC & FW), Government of India, 2020-21.

Vavilov, N. I. (1935) Origin and geography of cultivated plants. *Archives of natural history*, 21(1): 142.

Prasad VM, Kushwaha A. Effect of Foliar Application of Micronutrients on Growth, Yield and Quality of Tomato (*Solanum lycopersicum* L.) cv. Arka Samrat. *International Journal of Plant & Soil Science*. 2022 Jul 13;34(21):335-42.

