Original Research Article

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 Flavour. 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 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 tomato for all traits. Among the treatments tested, T_3 showed the most favorable 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, maximum number of fruits per plant, and yield per plant. T_3 was composed of GA_3 @ 75 ppm.

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 treated as “protective food” universally. Cherry Tomato known as poor man’s apple (orange) in India & love of apple in England. Tomato 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 horticulture crop belongs to the family Solanaceae bearing chromosome number 2n=2X=24 (Fedorov, 1969). It originated from 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 contain 93.1% water, 1.9% protein, 0.3 g fat, 0.7% fibre, 3.6%carbohydrates, 23 calorie, 320 I.U 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 tomato. Tomato is a warm season crop. The best fruit colour and quality is obtained at a temperature range of 21-24°C. Tomato is one of the 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, dietary fibres, and it has many other uses tomato seed contain 24% of oil is used as salad oil and in the manufacture of margarine. 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 (GA_3) 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.

MATERIAL AND 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 *Rabi* season of 2022. The different combination doses of organic manures and inorganic fertilizers mentioned in table 1 and replicated thrice. Observations were recorded at different stages of growth periods. The data were statistically analysed by the method suggested by Fisher and Yates, 1963**.**

Table 1 Details of different doses of plant growth regulators (PGRs) used.

Treatment Symbols	**Treatment combination**
$\mathbf{T_0}$	Control
$\mathbf{T_1}$	GA_3@ 25 ppm
$\mathbf{T_2}$	GA_3@ 50 ppm
$\mathbf{T_3}$	GA_3@ 75ppm
$\mathbf{T_4}$	Auxin@ 25 ppm
$\mathbf{T_5}$	Auxin@ 50ppm
$\mathbf{T_6}$	Auxin@ 75 ppm
$\mathbf{T_7}$	Kinetin@ 25 ppm
$\mathbf{T_8}$	Kinetin@ 50 ppm
$\mathbf{T_9}$	Kinetin@ 75 ppm

Table 2 Performance of different treatment of PGRs on growth and yield parameters studied for Cherry tomato.

Treatment Notation	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**
S.E. (m) ±		**0.08**	**0.54**	**0.27**	**0.24**	**0.23**	**0.11**	**0.58**	**6.96**	**0.16**	**0.15**	**0.20**	**0.06**	**0.02**
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 T_3 (GA_3 @ 75 ppm) followed by T_6 (Auxin @ 75 ppm) with 116.12 cm. Minimum plant height (96.20 cm) was observed in T_0 (Control), while the remaining treatments were moderate in their growth habit. The application of plant growth regulators (PGRs) 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 due to non-availability of nutrients. Similar findings were reported by Farooq *et al*. (2018); Kumar *et al*. (2018) and Alam *et al.* (2019) in tomato.

Number of primary branches per plant

It is evident that the number of branches per plant was influenced by different treatments at all successive stage of growth. There was significant difference between the treatments at among the treatments applied. It was also found that T_3 (GA_3@ 75ppm) with maximum value i.e., 13.40 branches per plant followed by T_9 (Kinetin @ 75 ppm) with 12.27 branches per plant whereas the minimum branches were observed in treatment T_0 (Control) with 7.73. It was noticed that number of branches per plant increased with increasing plant height successively with the increasing levels of micronutrient. Combination of plant growth regulators (PGRs) also recorded maximum plant height and number of branches also which helped the plants in better photosynthesis to attain vigour. The findings of the present investigation are in conformity with the reports of Farooq *et al.* (2018); Kumar *et al.* (2018) and Alam *et al.* (2019) in tomato.

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 was seen in T_3 (GA_3@ 75ppm) with 35.00 days, followed by T_7 (Kinetin @ 25ppm) with 36.00 days whereas maximum days to first flowering 47.33 days was recorded in T_0 (Control). Among the application of plant growth regulators (PGRs) the minimum days to first fruit setting was seen in T_3 (GA_3@ 75ppm) with 51.00 days, followed by T_7 (Kinetin @ 25ppm) with 51.67 days whereas maximum days to first fruit setting 63.33 days was recorded in T_0 (Control). Among the application of plant growth regulators (PGRs) the minimum days to first fruit picking was seen in T_3 (GA_3@ 75ppm) with 63.33 days, followed by T_7 (Kinetin @ 25ppm) with 75.67 days whereas maximum days to first fruit picking 75.67 days was recorded in T_0 (Control). Integration of different nutrient management favoured vigorous growth and synthesized more 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 reproductive phase. Similar results have also been reported by Farooq *et al*. (2018); Islam *et al*. (2018), Alam *et 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, fruit weight (g) and fruit diameter (cm)

Among the application of plant growth regulators (PGRs) the maximum number of flower clusters per plant was seen in T_3 (GA_3@ 75ppm) with 12.53 clusters followed by T_2 (GA_3@ 50 ppm) with 12.52 flowers whereas minimum number of flower clusters per plant 9.27 flowers was recorded in T_0 (Control). Among the application of plant growth regulators (PGRs) the maximum number of fruit set per plant was seen in T_3 (GA_3@ 75ppm) with 22.71 flowers followed by T_1 (GA_3@ 25ppm) with 18.08 flowers whereas minimum number of fruit set per plant 21.94 flowers was recorded in T_0 (Control). The maximum number of fruits per plants 284.72 fruits were recorded in treatment T_3 (GA_3@ 75ppm) followed by T_7 (Kinetin@ 25 ppm) i.e., 239.87 fruits and the lowest fruits per plant 167.63 were observed in T_0 (Control). The maximum average weight of fruit 31.15 g was recorded in treatment T_3 (GA_3 @ 75ppm) followed by T_6 (Auxin @ 75 ppm) i.e., 29.62 g and the lowest weight of fruit 12.98 g were observed in T_0 (Control). The maximum average yield per plant 8.10 kg/plant were recorded in treatment T_3 (GA_3 @ 75ppm) followed by T_6 (Auxin @ 75 ppm) i.e., 6.45 kg/plant and the lowest yield per plant 2.21 kg/plant were observed in T_0 (Control). Maximum number of fruits per plant increase of T_3 (GA_3@ 75 ppm) might be due to 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 these hormones in plants, which might have helped to 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 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); Alam *et al*. (2019) and Mishra *et al.*, (2019) in tomato.

Quality parameter

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

The maximum TSS 6.24 °Brix were recorded in treatment T_3 (GA_3 @ 75ppm) followed by T_5 (Auxin @ 50 ppm) i.e., 6.14 °Brix and the lowest TSS 3.80 °Brix were observed in T_0 (Control). The maximum Acidity 14.50 mg/100g were recorded in treatment T_3 (GA_3 @ 75ppm) followed by T_4 (Auxin @ 25 ppm) i.e., 14.15 mg/100g and the lowest acidity 9.42 mg/100g were observed in T_0 (Control). The maximum Acidity 1.55% were recorded in treatment T_3 (GA_3 @ 75ppm) followed by T_1 (GA_3 @ 25 ppm) i.e., 1.31% and the lowest acidity 0.28% were observed in T_0 (Control). PGRs play an important role in improving productivity and quality of fruit. Added dose of nutrients increased the vigour of plants, assimilating area, size of fruit, thereby resulting into 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); Alam *et al*. (2019) and Mishra *et al.*, (2019) in tomato.

Summary and Conclusion

The current study found that the use of plant growth regulators had a significant positive impact on the germination, growth, and development of tomatoes. Among the treatments tested, T_3 showed the most favorable results in terms of plant growth and fruit yield and quality. T_3 was composed of GA_3@ 75 ppm.

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.