



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

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## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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## 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,  $T_3(GA_3 @ 75 \text{ ppm})$

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showed the most favourable results in terms of plant height, number of primary branches, early flowering and maturing. T<sub>3</sub> 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<sub>3</sub>.

## 1. 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  $2n=2X=24$ ” [1]. “It originated in South America” [2]. “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 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 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” [3]. 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<sub>3</sub>) 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.

## 2. MATERIALS 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 2022-23. 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 T<sub>0</sub>(Control), T<sub>1</sub>(GA<sub>3</sub>@ 25 ppm), T<sub>2</sub> (GA<sub>3</sub>@ 50 ppm), T<sub>3</sub>(GA<sub>3</sub>@ 75ppm), T<sub>4</sub> (Auxin@ 25 ppm), T<sub>5</sub> (Auxin@ 50ppm), T<sub>6</sub> (Auxin@ 75 ppm), T<sub>7</sub>(Kinetin@ 25 ppm), T<sub>8</sub>(Kinetin@ 50 ppm), and T<sub>9</sub> (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 <sub>0</sub> (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 <sub>1</sub> (GA <sub>3</sub> @ 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 <sub>2</sub> (GA <sub>3</sub> @ 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 <sub>3</sub> (GA <sub>3</sub> @ 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 <sub>4</sub> (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 <sub>5</sub> (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 <sub>6</sub> (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 <sub>7</sub> (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 <sub>8</sub> (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 <sub>9</sub> (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

### 3. RESULTS AND DISCUSSION

#### 3.1 Growth Parameters

##### 3.1.1 Plant height (cm)

The maximum plant height (117.02 cm) at harvest was observed with treatment T<sub>3</sub> (GA<sub>3</sub> @ 75 ppm) followed by T<sub>6</sub> (Auxin @ 75 ppm) with 116.12 cm. "Minimum plant height (96.20 cm) was observed in T<sub>0</sub> (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. [4]; Kumar et al. [5] and Alam et al. [6] in tomatoes.

##### 3.1.2 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 T<sub>3</sub> (GA<sub>3</sub>@ 75ppm) with maximum value i.e., 13.40 branches per plant followed by T<sub>9</sub> (Kinectin @ 75 ppm) with 12.27 branches per plant whereas the minimum branches were observed in treatment T<sub>0</sub> (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. [4]; Kumar et al. [5] and Alam et al. [6] in tomatoes.

##### 3.1.3 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 T<sub>3</sub> (GA<sub>3</sub>@ 75 ppm) with 35.00 days, followed by T<sub>7</sub> (Kinectin @ 25ppm)with 36.00 days whereas maximum days to first flowering 47.33 days were recorded in T<sub>0</sub> (Control). Among the application of plant growth regulators (PGRs) the minimum days to first fruit setting were seen in T<sub>3</sub> (GA<sub>3</sub>@

75 ppm) with 51.00 days, followed by T<sub>7</sub> (Kinectin @ 25ppm)with 51.67 days whereas maximum days to first fruit setting 63.33 days were recorded in T<sub>0</sub> (Control). Among the application of plant growth regulators (PGRs) the minimum days to first fruit picking were seen in T<sub>3</sub> (GA<sub>3</sub>@ 75ppm) with 63.33 days, followed by T<sub>7</sub> (Kinectin @ 25ppm)with 75.67 days whereas maximum days to first fruit picking 75.67 days were recorded in T<sub>0</sub> (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. [4]; Islam et al. [5], Alam et al. [6] and Mishra et al., [7] in tomato.

##### 3.1.4 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 T<sub>3</sub> (GA<sub>3</sub>@ 75ppm) with 12.53 clusters followed by T<sub>2</sub> (GA<sub>3</sub>@ 50 ppm) with 12.52 flowers whereas a minimum number of flower clusters per plant 9.27 flowers was recorded in T<sub>0</sub> (Control). Among the application of plant growth regulators (PGRs) the maximum number of fruit set per plant was seen in T<sub>3</sub> (GA<sub>3</sub>@ 75ppm) with 22.71 flowers followed by T<sub>1</sub> (GA<sub>3</sub>@ 25ppm)with 18.08 flowers whereas minimum number of fruit set per plant 21.94 flowers was recorded in T<sub>0</sub> (Control). The maximum number of fruits per plants 284.72 fruits was recorded in treatment T<sub>3</sub> (GA<sub>3</sub>@ 75ppm) followed by T<sub>7</sub> (Kinectin@ 25 ppm) i.e., 239.87 fruits and the lowest number of fruits per plant 167.63 were observed in T<sub>0</sub> (Control). The maximum average weight of fruit 31.15 g was recorded in treatment T<sub>3</sub> (GA<sub>3</sub> @ 75ppm) followed by T<sub>6</sub> (Auxin @ 75 ppm) i.e., 29.62 g and the lowest weight of fruit 12.98 g were observed in T<sub>0</sub> (Control). The maximum average yield per plant of 8.10 kg/plant was recorded in treatment T<sub>3</sub> (GA<sub>3</sub> @ 75ppm) followed by T<sub>6</sub> (Auxin @ 75 ppm) i.e., 6.45 kg/plant and the lowest yield per plant was 2.21 kg/plant were observed in T<sub>0</sub> (Control). "The Maximum number of fruits per plant increase of T<sub>3</sub> (GA<sub>3</sub>@ 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 [8]; Farooq et al. [4]; Kumar et al., [5]; Islam et al. [9], Ansary et al., [10]; Alam et al. [6] and Mishra et al., [7] in tomato.

### 3.1.5 Quality parameter

**TSS [°Brix], Ascorbic acid content (mg/100g) and acidity (%):** The maximum TSS of 6.24 °Brix was recorded in treatment T<sub>3</sub> (GA<sub>3</sub> @ 75ppm) followed by T<sub>5</sub> (Auxin @ 50 ppm) i.e., 6.14 °Brix and the lowest TSS of 3.80 °Brix was observed in T<sub>0</sub> (Control). The maximum Acidity of 14.50 mg/100g was recorded in treatment T<sub>3</sub> (GA<sub>3</sub> @ 75ppm) followed by T<sub>4</sub> (Auxin@ 25 ppm) i.e., 14.15 mg/100g and the lowest acidity of 9.42 mg/100g was observed in T<sub>0</sub> (Control). The maximum Acidity of 1.55% was recorded in treatment T<sub>3</sub> (GA<sub>3</sub> @ 75ppm) followed by T<sub>1</sub> (GA<sub>3</sub> @ 25 ppm) i.e., 1.31% and the lowest acidity 0.28% was observed in T<sub>0</sub> (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 [8]; Farooq et al. [4]; Kumar et al., [5]; Islam et al. [9], Ansary et al., [10]; Alam et al.[6] and Mishra et al., [7] in tomato [11-13].

## 4. 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, T<sub>3</sub> (GA<sub>3</sub> @ 75 ppm) showed the most favourable results in terms of plant growth and fruit yield and quality.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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