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Effect of Plant Growth Regulators on Growth and Yield of Tomato (*Lycopersicon esculentum* L.)

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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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Original Research Article

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ABSTRACT

This investigation was undertaken to study "the effect of plant growth regulators on growth and yield of tomato (*Lycopersicon esculentum* L.) during *Kharif* season of 2021 at the Crop Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P), India. The experiment was laid out in a randomized block design with 10 treatments and each replicated thrice. The treatments consisted of plant growth regulators GA_3 at 10, 20 and 30 ppm, NAA at 10, 20 and 30 ppm and 2,4-D at 2,3, and 4ppm and a control plot. The results showed that among all the treatments, foliar application of GA_3 (30 ppm) had positive impact on growth, yield and quality parameters i.e., plant height (81.68 cm), number of clusters per plant (36.66), days to 50% flowering (63.11 days), flowers per plant (72.22), fruits per plant (55.33), fruit yield per plant (3.90 kg), fruit yield per hectare (58.5 t), total soluble solids (4.2^0 Brix) and acidity (0.41%) were obtained. Foliar application of GA_3 (30 ppm) was found to be productive as it recorded major growth and yield attributes as compared to other treatments.

Keywords: GA3; NAA; tomato; yield; 2,4-D.

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1. INTRODUCTION

The most crucial element of a balanced diet is vegetables, which also serve as a type of nutrition. Next to China, India is the second-largest producer of vegetables, but it only has a 0.8 million hectare area to work with for its 18 million tonnes of tomato production. The tomato, Lycopersicon esculentum Mill., plays a significant role in both the fresh fruit market and the processed food industries globally. It follows the potato in terms of production in India. It is cultivated in a variety of climates. Protein, minerals, Vitamin A, thiamine, nicotinic acid, riboflavin, and ascorbic acid are all present in tomato fruit. In plants, the growth regulators that are readily available frequently fall short. The promotion is directly caused by the precise plant amounts [1].

In plants, the growth regulators that are readily available frequently fall short. The physiological processes are directly promoted, inhibited, or otherwise modified by the specific quantities present in the plants. Given that yield and growth are clearly correlated, the auxin group's 2,4-D and gibberellins' GA3 (naphthalene acetic acid) and 2,4-D (2,4-dichlorophenoxyacetic acid) can be utilised as growth regulators to increase tomato yield and quality [2].

Cell elongation, improved phototropism, apical development, respiration, and flower bud initiation are the main effects of NAA that have been noted. Gibberellins encourage shoot growth by speeding up cell division and elongation in the sub apical meristem region, which lengthens internodes and controls the sub apical meristem's mitotic activity. The plant height, entry node length days to flowering, acidity, and number of seeds per fruit were all dramatically decreased by 2,4-D, but it also increased fruit set, number of fruits, TSS, number of secondary roots, and yield [1].

2. MATERIALS AND METHODS

A field experiment entitled “Effect of GA3, NAA and 2,4-D on plant growth and yield of tomato” carried out on the Experimental Field, Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, India during the *Kharif* of season 2021. The climate of the region is semi-arid subtropical.

2.1 Experimental Design and Treatment Combinations

The experiment was laid out in Randomized Block Design. The treatment consisted of three levels of GA3 (10 ppm, 20 ppm, 30 ppm), three levels of NAA (10 ppm, 20 ppm, 30 ppm) and 2,4-D (2 ppm, 3 ppm, 4 ppm) which were applied in the form of foliar application and a control plot. The treatments are T_0 control, T_1 GA3 10 ppm, T_2 GA3 20 ppm, T_3 GA3 30 ppm, T_4 NAA 10 ppm, T_5 NAA 20 ppm, T_6 NAA 30 ppm, T_7 2,4-D 2 ppm, T_8 2,4-D 3 ppm and T_9 2,4-D 4 ppm. The 9 nine treatments were replicated thrice.

2.2 Crop Management

Tomato variety (TMTH288) was transplanted at the rate of 500 g/ha. This is a new hybrid variety developed by Trimurti Plant Sciences P Limited Hyderabad, Telangana, India. This tomato hybrid is suitable for cultivation during *Kharif* and *Rabi* seasons and has yield potential. Harvesting starts from 75-80 days after transplanting. It is a semi-determinate plant type. The average weight of fruit varies from 90-100 g and was firm. The recommended dose of fertilizer is 200:250:250 NPK kg/ha. The nutrient sources were Urea, SSP and MOP to fulfill the requirement of nitrogen, phosphorous and potassium. The tomato plants were irrigated 6-7 times. Weedings was done 3-4 manually with hand hoe (khurpi).

3. RESULTS AND DISCUSSION

The field experiment entitled was aimed at identifying various levels of plant growth regulators. Nine treatment combination and a control plot was evaluated during *Kharif* season of 2021 in the experimental field of Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, India.

3.1 Effect of Plant Growth Regulators on Growth Attributes of Tomato

3.1.1 Survival percentage

The perusal of data revealed that the effect of plant growth regulators on survivalpercentage of transplanted plants was found significant [3-6].

3.1.2 Plant height (cm)

At 45 days after transplanting with application of T_3 (GA3 30 ppm) was recorded maximum plant height (81.68 cm) which was significantly higher over rest of the treatments expect treatment with application of T_2 (GA3 20 ppm) was recorded with (80.36 cm) were statistically at par to the application of T3 (GA3) and lowest height (65.76 cm) was recorded in the control plot [7-10].

3.1.3 Number of clusters per plant

Based on the application of various plant growth regulators varying different treatments to tomato crop maximum number of clusters (36.66) per plant was recorded in the treatment 3 with application of (GA3 30 ppm)which was statistically at par with treatment 2 with application of (GA3 20 ppm)was (35.44). Lowest number of clusters per plant (23.66) was recorded in the control plant with application of Recommended Dose of Fertilizer. The data pertaining to number of clusters per plantare presented in the Table 1.

Table 1. Performance of growth attributes in tomato by growth regulators

Treatments	Survival percentage (%)	Plant height (cm)	No. of clusters/plant	Days to 50% flowering	No. of flowers/plant
Control	91.33	65.76	23.66	78.22	50.22
GA3 10 ppm	93.67	77.06	33.44	67.33	64.67
GA3 20 ppm	94.67	80.36	35.44	64.00	70.11
GA3 30 ppm	96.67	81.68	36.66	63.85	72.22
NAA 10 ppm	93.33	72.68	29.55	73.11	59.44
NAA 20 ppm	94.33	73.58	31.11	71.44	60.77
NAA 30 ppm	94.67	74.92	32.00	69.33	63.44
2,4-D 2 ppm	94.33	71.92	27.77	77.00	57.11
2,4-D 3 ppm	92.67	70.42	25.89	76.44	55.44
2,4-D 4 ppm	91.67	68.53	25.33	75.44	52.78

Table 2. Performance of quality parameters in tomato by plant growth regulators

Treatments	No. of fruits/plant	Fruit yield/plant (kg)	Fruit yield/plot (kg)	Fruit yield/hectare (t/ha)
Control	35.33	2.70	16.20	40.5
GA3 10 ppm	50.77	3.50	21	52.5
GA3 20 ppm	54.22	3.79	22.40	56
GA3 30 ppm	55.33	3.90	23.40	58.5
NAA 10 ppm	43.55	3.17	19	47.5
NAA 20 ppm	45.00	3.40	20.40	51
NAA 30 ppm	48.44	3.53	21.20	53
2,4-D 2 ppm	42.33	3.23	19.40	48.5
2,4-D 3 ppm	40.77	3.10	18.60	46.5
2,4-D 4 ppm	39.33	2.83	17	42.5

Table 3. Performance of quality parameters in tomato by plant growth regulators

Treatments	TSS^0 (Brix)	Acidity (%)
Control	3.27	0.31
GA3 10 ppm	3.9	0.38
GA3 20 ppm	4.1	0.39
GA3 30 ppm	4.2	0.41
NAA 10 ppm	3.6	0.37
NAA 20 ppm	3.9	0.38
NAA 30 ppm	4	0.4
2,4-D 2 ppm	3.5	0.35
2,4-D 3 ppm	3.4	0.34
2,4-D 4 ppm	3.3	0.32

3.2 Number of Flowers Per Plant

Based on the application of various plant growth regulators varying different treatments to tomato crop maximum number of flowers (72.22) per plant was recorded in the treatment 3 with application of (GA3 30 ppm) which was statistically at par with treatment 2 with application of (GA3 20 ppm) was (70.11). Lowest number of fruits per plant (50.22) was recorded in the control plant with application of Recommended Dose of Fertilizer. The data pertaining to number of clusters per plant are presented in the Table 1.

3.3 Effect of Plant Growth Regulators on Yield Attributes of Tomato

Fruits per plant: Treatments with application of T_3(GA3 30 ppm) was recorded with maximum (55.33) fruits per plant which was superior to other treatments, where as treatment with T_2 (GA3 20 ppm) was recorded with (54.22) were statistically at par with treatment T_3.The data pertained to this was shown in the Table 3.

Fruit yield per plant: Treatments with application of T_3(GA3 30 ppm) was recorded with maximum (3.90 kg) fruit yield per plant which was superior to other treatments, where as treatment with T_2 (GA3 20 ppm) was recorded with (3.79 kg) were statistically at par with treatment T_3.The data pertained to this was shown in the Table 2.

Fruit yield per plot: Treatments with application of T_3(GA3 30 ppm) was recorded with maximum (23.40 kg) fruit yield per plant which was superior to other treatments, where as treatment with T_2 (GA3 20 ppm) was recorded with (22.40 kg) were statistically at par with treatment T_3.The data pertained to this was shown in the Table 2.

Fruit yield per hectare: Treatments with application of T_3(GA3 30 ppm) was recorded with maximum (58.5tonnes) fruit yield, which was superior to other treatments, whereas, treatment with T_2 (GA3 20 ppm) was recorded with (56tonnes) were statistically at par with treatment T_3. The data pertained to this was shown in the Table 2.

3.3 Effect of Plant Growth Regulators on Quality Parameters of Tomato

Total soluble solids (^{0}Brix): Total soluble solids content of fruits are ranged from 3.2^{0}Brix (T0) to 4.2^{0}Brix (T3). Highest TSS reading 4.2 (^{0}Brix) was recorded in the treatment T3 (GA3 @30 ppm) which may be due to thicker pericarp than pollinated fruits throughout its development and TSS is response to GA3. Minimum TSS 3.2^{0}Brix (T1) was recorded for treatments (T0). All treatments are found significant. Variation in TSS may be due to foliar application of GA3, NAA and 2,4-D (Table 3.).

Acidity (%): Acidity (%) content of fruits ranged from 0.31 % (T0) to 0.41 % (T3). Highest acidity ranged 0.41 % was recorded in the treatment T3 (GA3 @ 30 ppm) which may be due to variety and have pH values slightly above (4.6). Minimum Acidity 0.31 %was recorded for treatments (T0) control. Treatments are T2, T4, T5, T7, T10, found significant. Variation in acidity (%) may be due to foliar application of GA3 @ 50 ppm in per ha (Table 3).

4. CONCLUSION

Considering the result, it is concluded that treatment 3 with GA3 30 ppm/ha recorded the highest fruit yield (58.5 t/ha) and was found to be the best treatment for improved plant growth and yield. Based on the above results treatment 3 can be recommended for cultivation of tomatoes in UP conditions.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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