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The effect of micronutrients and GA₃ on growth and yield of tomato (*Lycopersicon esculentum* Mill.) cv. Kashi Chayan

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Abstract

This study was conducted with the objective to determine the effect of micronutrients and GA₃ on growth and yield of Tomato (*Lycopersicon esculentum* Mill.) cv. Kashi Chayan and an experiment was conducted at the horticultural farm, Udai Pratap (Autonomous) College, Varanasi (U.P.) during Rabi season of 2023-2024. Experiment was laid out in a randomized block design (RBD) with seven treatments replicated three times comprising GA₃ and micronutrients with control i.e. T₁: GA₃ (50ppm), T₂: GA₃ (100ppm), T₃: ZnSO₄ (0.5%), T₄: ZnSO₄ (1%), T₅: Boric acid (50ppm), T₆: Boric acid (100ppm) and T₇: Control. Significantly, differences were found for plant growth parameters viz. plant height (cm), number of branches plant⁻¹, number of flower cluster⁻¹, number of cluster plant⁻¹, was recorded highest in T₂: GA₃ (100ppm). The treatment T₂: GA₃ (100ppm) was also found best in early days to 50% flowering, days to first fruit set and yield attributes viz., no. of fruit per cluster, no. of fruit plant⁻¹, average fruit weight (g), fruit length (cm), fruit width (cm), fruit yield per plant (kg) and fruit yield (q/ha) in tomato cv. Kashi Chayan. It is revealed that the use of GA₃ at the concentration of 100ppm, considerably increased the vegetative growth parameters and significantly increased growth and yield of tomato.

Keywords: Micronutrients, GA₃, Growth and Yield

Introduction

Tomato (*Lycopersicon esculentum* Mill.) is a member of the Solanaceae family and is a diploid species with a chromosome number of 2n=24. Originally native to Peru and Mexico, it is now widely cultivated across the globe due to its ability to thrive in a variety of soil types and climates (Gerszberg *et al.*, 2015) [4]. The top tomato-producing countries include China, the United States, India, Egypt, Turkey, Iran, Mexico, Brazil, and Indonesia [FAO, 2022]. Tomato is a warm-season crop that is sensitive to cold temperatures (Afshari *et al.*, 2014) [1]. It can be cultivated in both the wet and dry seasons, provided the annual rainfall ranges from 60 to 150 cm. However, excessive rainfall during its growth period can be detrimental to the plant. Micronutrients play a crucial role in plant processes, and foliar application of these nutrients can enhance both the quality and yield of tomatoes (Ali *et al.*, 2012) [2] by boosting the photosynthetic activity in green plants (Singh and Tiwari, 2013) [13]. Micronutrients management is essential to boost the crop production and also increased the fruits quality. Boron and zinc important micronutrient for quality tomato fruit production. Zinc regulates growth and also promotes balanced sugar consumption and Boron helps to providing some nutrients and essential for proper development of their fruits and seeds. Gibberellic acid is a key growth regulator with various potential applications for altering plant growth, yield, and yield-related traits (Rafeekher). Considering the facts, the current study aims to examine the effects of Micronutrients and GA₃ on the growth and yield of tomato.

Materials and Methods

A field experiment entitled "The effect of micronutrients and GA₃ on growth and yield of Tomato (*Lycopersicon esculentum* Mill.) cv. Kashi Chayan" was conducted at the experimental field of Department of Horticulture, Udai Pratap (Autonomous) College, Varanasi (U.P.) during Rabi season of 2023-2024. Experiment was laid out in a randomized

block design (RBD) with seven treatments replicated three times comprising GA₃ and micronutrients with control i.e. T₁: GA₃ (50ppm), T₂: GA₃ (100ppm), T₃: ZnSO₄ (0.5%), T₄: ZnSO₄ (1%), T₅: Boric acid (50ppm), T₆: Boric acid (100ppm) and T₇: Control. The collected data includes plant height (cm), number of branches plant⁻¹, number of flower cluster⁻¹, number of cluster plant⁻¹, early days to 50% flowering, days to first fruit set and yield attributes viz., no. of fruit per cluster, no. of fruit plant⁻¹, average fruit weight (g), fruit length (cm), fruit width (cm), fruit yield per plant (kg) and fruit yield (q/ha) in tomato cv. Kashi Chayan. The data was analyzed using analysis of variance (ANOVA), and mean separation was performed at a 5% probability level Sahu *et al.*, (2022) ^[12].

Results and Discussion

The data on the effects of various micronutrients and GA₃ on plant height at different growth stages were statistically analyzed and are detailed in Table 1. It clearly showed that the plant height differed significantly with each other, the maximum plant height (118.23 cm) was recorded in the treatment T₂ (GA₃ @ 100 ppm). The minimum plant height was noted 92.40 cm at the time of harvesting in treatment T₇ (Control). The data on the effects of various micronutrients and GA₃ on no. of branches per plant at different growth stages were statistically analyzed and are detailed in Table 1. It clearly showed that the no. of branches differed significantly with each other, the highest no. of branches (11.95) was recorded in the treatment T₂ (GA₃ @ 100 ppm). The lowest no. of branches was noted 7.10 at the time of harvesting in treatment T₇ (Control).

The shortest duration to reach 50% flowering in tomato plants was observed in treatment T₂ (GA₃ @ 100 ppm), requiring just 62.34 days. This was followed by treatment T₁ (GA₃ @ 50 ppm), which required 64.29 days. In contrast, the longest duration of 76.51 days to reach 50% flowering was recorded in the control treatment T₇. Onofeghara (1981) ^[8] reported similar findings, attributing them to the role of GA₃ in regulating flower initiation and development. GA₃ is crucial for both male and female fertility (Griffiths *et al.*, 2006) ^[5]. The data on the effects of various micronutrients and GA₃ on no. of flower per cluster were statistically analyzed and are detailed in Table 1. The highest number of flowers per cluster, averaging 6.86, was observed in treatment T₂ (GA₃ @ 100 ppm). This was followed by T₁ (GA₃ @ 50 ppm) and T₆ (Boric acid @ 100 ppm), which had 6.47 and 5.38 flowers per cluster, respectively. The highest number of clusters per plant, at 5.86, was observed in treatment T₂ (GA₃ @ 100 ppm), followed by T₁ (GA₃ @ 50 ppm). Both micronutrients and GA₃ had a notable impact on the days to the first fruit set during the 2023-24 period. The shortest duration to the first fruit set, at 72.77 days, was observed in treatment T₂ (GA₃ @100 ppm), followed by T₁ (GA₃ @ 50 ppm). Both micronutrients and GA₃ had a considerable impact on the timing of the first fruit picking during the 2023-24 period. The shortest time to the first fruit picking, at 87.20 days, was recorded in treatment T₂ (GA₃ @100 ppm), followed by T₁ (GA₃ @50 ppm) at 88.35 days.

The data on the effects of various micronutrients and GA₃ on no. of fruits per plant were statistically analyzed and are detailed in Table 2. Among the treatments, T₂ (GA₃ @ 100 ppm) yielded the highest number of fruits per plant at 47.80, showing a significant improvement compared to other treatments. This was followed by T₁ (GA₃ @ 50 ppm), which produced 44.60 fruits per plant. In contrast, the control (T₇) recorded a significantly lower number of fruits per plant (22.43).

The longest fruit length, measuring 6.10 cm, was observed in treatment T₂ (GA₃ @ 100ppm), which was significantly superior to other treatments. This was followed by T₁ (GA₃ @ 50 ppm) and T₄ (ZnSO₄ @ 1%), with fruit lengths of 5.98 cm and 5.05 cm, respectively. The shortest fruit length, at 3.57 cm, was recorded in the control group T₇. The results of various levels of micronutrients and GA₃ across different treatment combinations are shown in Table 2. The greatest fruit width, measuring 5.14 cm, was observed in treatment T₂ (GA₃ at 100 ppm), followed by T₁ (GA₃ at 50 ppm) at 4.98 cm. The results of various levels of micronutrients and GA₃ across different treatment combinations are shown in Table 2. The weight of individual tomato fruits varied significantly with the application of different levels of GA₃ and micronutrient. The highest average fruit weight (104.46g), was recorded in treatment T₂ (GA₃ @ 100 ppm), followed by T₁ (101.73g) and T₄ (98.40g). The lowest average fruit weight, 82.32g, was observed in the control (T₇). These findings are reported by Lilov and Donchev (1984) ^[7] Naeem *et al.* (2001) ^[9].

The results of various levels of micronutrients and GA₃ across different treatment combinations are shown in Table 2. Statistical analysis of the data on tomato fruit yield per plant (Kg) revealed significant differences. Different levels of GA₃ had a significant impact on the yield of fruit per plant. The highest yield, at 3.33 kg per plant, was achieved with 100 ppm GA₃, while the lowest yield, 1.56 kg per plant, was observed under control conditions. The results of various levels of micronutrients and GA₃ across different treatment combinations are shown in Table 2. Statistical analysis of the data on tomato fruit yield per hectare (q) revealed significant differences. The application of different levels of GA₃ significantly affected the fruit yield per hectare. The highest yield, 437.35 q/ha, was obtained with T₂ (GA₃ @ 100 ppm), followed by T₁ (GA₃ @ 50 ppm) at 407.87 q/ha whereas the lowest yield, 240.56 q/ha, was recorded in the control (T₇).

Conclusion

The results of the present study indicate that the application of GA₃ (50 ppm and 100 ppm) and micronutrients such as ZnSO₄ (0.5% and 1%) and boric acid (50 ppm and 100 ppm) notably enhanced vegetative growth, flowering, and significantly boosted tomato yield. Based on these findings, it can be concluded that GA₃ at a concentration of 100 ppm was the most effective treatment for improving both vegetative growth and yield in tomato variety Kashi Chayan.

Table 1: Effect of micronutrients and GA₃ on plant height, no. of branches, days to 50% flowering, no. of flower per cluster, no. of cluster per plant, days to first fruit set and days to first fruit picking

Tr. No.	Treatment details	Plant height (cm)	No. of branches	Days to 50% flowering	No. of flower per cluster	No. of cluster per plant	Days to first fruit set	Days to first fruit picking
T ₁	GA ₃ (50ppm)	115.75	11.03	64.29	6.47	4.37	73.51	88.35
T ₂	GA ₃ (100ppm)	118.23	11.95	62.34	6.86	5.86	72.77	87.20
T ₃	ZnSO ₄ (0.5%)	107.47	10.25	72.31	5.12	3.98	77.15	91.92
T ₄	ZnSO ₄ (1%)	109.32	10.98	71.03	5.26	4.32	76.87	89.99
T ₅	Boric Acid (50ppm)	110.87	9.33	68.01	5.28	4.28	77.67	92.85
T ₆	Boric Acid (100ppm)	112.17	9.98	67.20	5.38	4.08	76.37	90.98
T ₇	Control	92.40	7.10	76.51	4.24	3.24	80.11	94.01
SEm±		1.95	0.13	1.44	0.05	0.04	1.45	1.36
CD at 5%		6.02	0.41	4.44	0.17	0.13	4.47	4.19

Table 2: Effect of Micronutrients and GA₃ on no. of fruits per plants, fruit length (cm), fruit width (cm), fruit weight (g), fruit yield (kg/plant) and fruit yield (q/ha)

Tr. No.	Treatment details	No. of fruits per plant	Fruit length (cm)	Fruit width (cm)	Fruit weight (g)	Fruit yield (Kg/plant)	Fruit yield (q/ha)
T ₁	GA ₃ (50ppm)	44.60	5.98	4.98	101.73	3.27	407.87
T ₂	GA ₃ (100ppm)	47.80	6.10	5.14	104.46	3.33	437.35
T ₃	ZnSO ₄ (0.5%)	37.47	4.93	4.18	97.07	2.89	304.76
T ₄	ZnSO ₄ (1%)	39.38	5.05	4.25	98.40	2.93	321.02
T ₅	Boric Acid (50ppm)	34.06	4.79	4.04	91.29	2.31	337.10
T ₆	Boric Acid (100ppm)	35.99	4.86	4.13	95.30	2.64	353.20
T ₇	Control	22.43	3.57	3.57	82.32	1.56	240.56
SEm±		0.71	0.07	0.07	1.01	0.03	6.43
CD at 5%		2.18	0.22	0.20	3.11	0.09	19.81

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