

COMBINED EFFECT OF GA₃ AND NAA ON GROWTH AND YIELD OF TOMATO

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ABSTRACT

A field experiment was conducted at the Horticulture Farm, Bangladesh Agricultural University, Mymensingh to study the combined effect of different levels of GA₃ and NAA on growth and yield of tomato. The experiment consisted of ten (10) treatments viz. T₀ = G₀N₀ (control), T₁ = GA₃ @ 40 ppm + NAA @ 5 ppm, T₂ = GA₃ @ 50 ppm + NAA @ 5 ppm, T₃ = GA₃ @ 60 ppm + NAA @ 5 ppm, T₄ = GA₃ @ 40 ppm + NAA @ 10 ppm, T₅ = GA₃ @ 50 ppm + NAA @ 10 ppm, T₆ = GA₃ @ 60 ppm + NAA @ 10 ppm, T₇ = GA₃ @ 40 ppm + NAA @ 15 ppm, T₈ = GA₃ @ 50 ppm + NAA @ 15 ppm, T₉ = GA₃ @ 60 ppm + NAA @ 15 ppm. Experiment laid out in the randomized complete block design (RCBD) with three replications. The results of the experiment revealed that the extent of plant establishment percentage, plant growth, day to first flowering, number of clusters plant⁻¹, number of flowers cluster⁻¹, number of flower plant⁻¹, number of fruits plant⁻¹, fruit weight plot⁻¹, fruit weight ha⁻¹ were significantly influenced by different concentrations of GA₃ and NAA. Combined effect of GA₃ and NAA produced the maximum plant succession percentage (100), plant height (71.33 cm), number of leaves plant⁻¹(36.89) and plant diameter at 67 DAT from the treatment G₂N₂ that means at treatment T₅. Maximum no. of clusters plant⁻¹ (15.11), no. of flowers cluster⁻¹ (6.11), number of flower plant⁻¹ (46.22), number of fruits plant⁻¹(13.44), individual fruit weight (85.70 g), fruit weight plant⁻¹(1.13kg), yield plot⁻¹(13.14 kg) and yield ha⁻¹ (36.50 tha⁻¹) obtained the treatment T₅.

Key words: Tomato, GA₃, NAA and growth.

Introduction

Tomato (*Lycopersicon esculentum* Mill.), belonging to the family *Solanaceae* is originated in tropical America (Salunkhe *et al.*, 1987) most likely in the region of Andes Mountain in Peru and Boloivia (McCollum, 1992). It is one of the most highly praised vegetables consumed widely and a major source of vitamins and minerals (Bose and Som, 1990). The low yield of tomato in Bangladesh, however, is still prevailing, where plant growth regulators (PGR's) might be used as a useful alternative to increase crop production. The most widely available plant growth regulator is GA₃ or gibberellic acid, which induces stem and internode elongation, seed germination, enzyme production during germination and fruit setting and growth. Naphthalene Acetic acid has an important effect on the fruit retention of several vegetables as well as horticultural crops and thus increasing the yield sustainability. Application of plant growth regulator for improving the yield and quality of many vegetable crops has been emphasized by several workers (Meena, 2008). However, the improvement in the yield and quality of the crops mainly depends on the concentration of plant growth regulator and time of application. Under the circumstances, the present piece of research was undertaken in view of the following objectives to study the combined effect GA₃ and NAA on growth and yield of tomato and to increase the yield of tomato by using plant hormones and to find out the best combination of GA₃ and NAA for obtaining the maximum yield.

Materials and Methods

The field experiment was conducted at the Horticultural Farm, Bangladesh Agricultural University, Mymensingh during the period from October, 2016 to February, 2017 to determine the effect of staking and stem pruning on the growth. The soil of the experimental plot was sandy loam in texture. It belongs to the

Old Brahmaputra Flood Plain under AEZ No. 9. The selected land was medium high in nature. The tomato variety used in the experiment was Roma VF. This is verticillium and fusarium wilt resistant high yielding indeterminate variety. Tomato seedlings were raised in one seed beds situated on a relatively high land adjacent to the Horticulture Farm office. The size of each seed bed was 1m x 1 m. Seeds were sown on the seed beds on 24th October 2016. Complete germination of the seeds took place within 4-6 days of sowing. Necessary shading by bamboo mat was provided over the seedbed to protect the young seedlings from the scorching sunshine or heavy rain. Dithane M-45 was sprayed on the seedbeds at the rate of 2gl⁻¹ to protect the seedlings from damping-off and other diseases. Weeding, mulching and water management were done from time to time as and when needed.

Design, layout and the treatments of the experiment: The single factor experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The treatment combination is given below: T₀=GA₃ @ 0 ppm + NAA @ 0 ppm (control), T₁= GA₃ @ 40 ppm + NAA @ 5 ppm, T₂= GA₃ @ 50 ppm + NAA @ 5 ppm, T₃= GA₃ @ 60 ppm + NAA @ 5 ppm, T₄= GA₃ @ 40 ppm + NAA @ 10 ppm, T₅= GA₃ @ 50 ppm + NAA @ 10 ppm, T₆= GA₃ @ 60 ppm + NAA @ 10 ppm, T₇= GA₃ @ 40 ppm + NAA @ 15ppm, T₈= GA₃ @ 50 ppm + NAA @ 15 ppm, T₉= GA₃ @ 60 ppm + NAA @ 15 ppm. GA and NAA were applied in 30 days aged transplanted plants.

The unit plot was 2m x 1.80 m in size with a distance between the blocks was 60 cm and that between unit plots was 50 cm. The selected land for sowing the crop was first opened with a tractor on 6th November 2016. Manure and fertilizers were applied uniformly in the experimental plots as per the following recommended doses.

Manures/fertilizers	Dose ha ⁻¹
Well decomposed cowdung	10 ton
Urea	550 kg
Triple super phosphate (TSP)	450 kg
Murate of Potash (MP)	250 kg

Transplanting of seedlings: Healthy seedling were taken separately from the seed beds and were transplanted in the experimental plots during late hours in the evening of 24th October maintaining a spacing of 60 cm between rows and 50 cm between the plants.

Intercultural operations: After transplanting the seedlings, various kinds of intercultural operations were accomplished for better growth and development of plants which are gap filling, weeding and mulching, Staking and pruning, Irrigation, plant protection (Insect pests and diseases) and harvesting. The harvesting was started from 4th January, 2017 and completed by 9th February, 2017.

Collection of data: Data on the following parameters were recorded from the sample plants during the course of experiment- plant succession rate, plant height, no. of leaves plant⁻¹, day to first flowering, no. of flowers cluster plant⁻¹, no. of flowers cluster⁻¹, no. of flowers plant⁻¹, no. of fruits plant⁻¹, fruit length, fruit diameter, weight of individual fruit, fruit yield plant⁻¹, fruit yield plot⁻¹, fruit yield (ha) etc.

Analysis of data: MSTAT-C computer program was used to analyze the data. The means of all the treatments were calculated and the analysis of variance was performed by F (Variance ratio) test. The differences among the treatment means were evaluated by Least Significant Difference (LSD) test for interpretation of results (Gomez and Gomez, 1984).

Results and Discussion

Combined Effects of GA₃ and NAA on the growth of tomato

The combined effect of GA₃ and NAA on plant succession rate was significant. The maximum plant succession rate was increased upto T₅. The lowest plant succession rate was at control plot (Table 1). Different levels of concentrations GA₃ and NAA exhibited significant variations in respect of plant height

and no. of leaves at different days after spraying. In case of increasing concentration of GA₃ and NAA, the plant height were increased but decreasing after G₂N₂ treatment. Plant height was maximum 29.89, 51.56 and 71.33 cm at 37, 52 and 67 DAT respectively at GA₃@50 ppm and NAA@10ppm. On the other hand, 24.00, 39.00, 41.22 cm, respectively plant height at control plot (Table 1). No. of leaves plant⁻¹ increased with the progress of time at irrespective of the no. of leaves plant⁻¹ was increased but decreasing after T₅. The highest leaf number (36.89) was recorded from T₅ and the lowest (29.00) from the controlled one at last days of recording (Table 1).

Table 1. Effect of treatments on plant success, plant height and no. of leaves plant⁻¹ of tomato

Treatment	Plant success %	Plant height at different DAS			No. of leaves plant ⁻¹ at different DAS		
		37 DAS	52DAS	67DAS	37 DAS	52DAS	67DAS
T ₁	91.67	24.67	45.78	65.22	11.90	24.33	30.00
T ₂	93.31	26.78	46.11	66.00	12.00	24.33	32.22
T ₃	97.22	29.00	46.89	65.67	12.67	25.00	34.44
T ₄	97.22	29.56	51.22	67.33	14.33	25.50	35.11
T ₅	100	29.89	51.56	71.33	15.78	26.00	36.22
T ₆	97.22	28.78	47.89	70.78	13.33	23.00	35.67
T ₇	97.22	28.56	47.11	62.89	13.44	24.75	36.89
T ₈	94.44	28.00	48.11	65.78	12.00	24.50	35.67
T ₉	91.67	27.00	49.67	67.78	11.25	24.30	34.44
Control (T ₀)	90.55	24.00	39.00	41.22	10.12	24.00	29.00
LSD 0.05	3.28	3.13	4.08	4.94	2.82	1.30	4.82
LSD 0.01	4.50	4.29	5.58	6.77	3.86	1.78	6.61
Level of Sig.	**	**	**	**	*	**	*

Days after sowing (DAS)

** = Significant at 1% level of probability, * = Significant at 5% level of probability T₀ = G₀N₀ (control), T₁=G₁N₁, T₂= G₁N₂, T₃ = G₁N₃, T₄ =G₂N₁, T₅= G₂N₂, T₆=G₂N₃, T₇=G₃N₁, T₈=G₃N₂, T₉=G₃N₃ and G₁:GA₃ @ 40 ppm N₁: NAA@ 5 ppm, G₂: GA₃ @ 50 ppm N₂: NAA@ 10 ppm and G₃: GA₃ @ 60 ppm N₃: NAA@ 15 ppm

Combined Effects of GA₃ and NAA on the yield and yield attributes of tomato

Significant variations were found in respect of different concentration of GA₃ and NAA on days to first flowering. It was found that early flowering occurred at G₂N₂ that means at treatment T₅. But flowering was 24 delayed at control plot. It took 33.89 days to first flowering at T₅ whereas it took 36.33 days to first flowering at control plot (T₀) (Table 2). The no. of flower clusters plant⁻¹ was significantly influenced by different concentration of GA₃ and NAA. The highest number (15.11) of flower clusters plant⁻¹ was found from G₂N₂ that means at treatment T₅ and the lowest no. (10.00) of flower clusters plant⁻¹ was found from control plot. The effect of different levels concentration of GA³ and NAA no. of flowers cluster⁻¹ showed significant influence. The highest number (6.11) of flowers per cluster was produced by G₂N₂ that means at treatment T₅ and the lowest number (3.71) was obtained from the control plot. A significant variation in the no. of flowers per plant was recorded due to the effects of different concentration of GA₃ and NAA). It was evident that from (table 5) G₂N₂ that means at treatment T₅ obtained the highest no. (46.22) of flowers plant⁻¹ and the lowest no. (34.33) was produced from controlled plot (Table 2).

Analysis of variance showed that different concentration of GA₃ and NAA had significant influences on the number of fruits plant⁻¹, individual weight of fruit, fruit wt. plant⁻¹ and fruit yield (Table 4). The maximum no. of fruits plant⁻¹ (13.44), individual fruit (85.70g), fruit wt. (1.13 kg plant⁻¹), yield (13.14 kg) plot⁻¹ and yield (36.50 tha⁻¹) were obtained by the combination of G₂N₂ that means at treatment T₅. Control treatment showed the worst performances for the above yield and yield attributing parameters of tomato (Table 2).

Table 2. Combined Effect of GA₃ and NAA yield and yield contributing attributes of tomato

Treatment	Days of first flowering	No. of cluster plant ⁻¹	No. of flowers cluser ⁻¹	No. of flower plant ⁻¹	No. of fruits plant ⁻¹	Individual wt. fruit ⁻¹ (g)	Fruit wt. plant ⁻¹ (kg)	Yield plot ⁻¹ (kg)	Yield t ha ⁻¹
T ₁	36.67	11.00	3.50	39.00	10.25	80.97	0.83	9.90	27.50
T ₂	36.33	11.11	4.00	39.25	11.00	81.50	0.86	10.26	28.50
T ₃	36.89	11.44	4.56	39.50	11.67	82.50	0.91	10.91	30.30
T ₄	35.89	11.50	5.50	42.50	12.00	83.45	1.04	12.47	35.75
T ₅	33.89	15.11	6.11	46.22	13.44	85.70	1.13	13.14	36.50
T ₆	35.44	12.67	4.89	41.78	12.33	84.30	1.05	12.60	35.00
T ₇	36.11	11.67	5.00	39.11	12.33	83.50	0.97	11.70	32.50
T ₈	36.00	11.33	4.89	38.56	11.25	78.00	0.80	9.54	26.50
T ₉	35.78	11.00	4.78	37.89	11.15	77.00	0.76	9.18	25.50
Control(T ₀)	36.33	10.00	3.78	34.33	9.44	75.00	0.74	8.82	24.50
LSD0.05	1.09	2.45	1.16	3.28	1.94	2.36	0.09	1.04	1.98
LSD0.01	1.50	3.36	1.59	4.50	2.66	3.24	0.13	1.42	2.71
Level of sig.	**	*	**	**	*	**	**	**	**

** = Significant at 1% level of probability, * = Significant at 5% level of probability T₀ = G₀N₀ (control), T₁=G₁N₁, T₂= G₁N₂, T₃ = G₁N₃, T₄ =G₂N₁, T₅= G₂N₂, T₆=G₂N₃, T₇=G₃N₁, T₈=G₃N₂, T₉=G₃N₃ and G₁:GA₃ @ 40 ppm N₁: NAA@ 5 ppm, G₂: GA₃ @ 50 ppm N₂: NAA@ 10 ppm and G₃: GA₃ @ 60 ppm N₃: NAA@ 15 ppm

Conclusion

From the present study it is obvious that the combined effect GA₃ and NAA had significant effect role on all growth parameters and yield of tomato. Here, the combination of GA₃ @ 50ppm and NAA@ 10 ppm may be suggested for better growth and yield for Roma VF variety of tomato.

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