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SHORT COMMUNICATION

Effect of plant growth regulators on growth and yield of tomato

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Introduction

Vegetable is the most important component of a balanced human diet and act as a protective food. Tomato is one of the most popular and widely grown vegetables in the world and India (Pal et al., 2023). Tomato is a day-neutral crop but requires more sunny days for its flowering and fruiting. Several factors affect the growth and yield of crops. Besides genetic and environmental interaction, nutrition and agronomic practices also play a significant role in yield maximization nowadays. Sustainable agricultural scenarios and the interaction of plant nutrient systems in the form of organic, inorganic and biological components create attention (Singh et al., 2013; Singh et al., 2015). Plant growth substances are essential for the growth and development of tomatoes. It plays an important role in flowering, fruit set, ripening and physiochemical changes during the storage of tomato. The use of GA_3 and NAA in tomatoes is well-established. Therefore, studies on the morphological and yield parameters of tomatoes as affected by GA_3 and NAA may lead to a finding that could be practically good and remunerative to the farmers (Rodrigues et al., 2001). The use of plant growth regulators has improved the production of tomatoes including other vegetables, concerning good plant growth and quality. However, little is known about the relationship between the regulation of hormones on fruit number occurrence and the yield of tomatoes. In the present study, gibberellic $acid_3$ (GA_3) and naphthalene acetic acid (NAA) were used to regulate plant growth, and fruit number and fruit yield of different treatments. The object of this study was to determine the effect of external hormones on the growth and yield of tomato fruits.

An experiment was carried out at the Experimental Farm of Horticulture Research, Department of Horticulture, Udai Pratap Autonomous College, Varanasi, UP during the winter season of 2016-2017. The sources of tomato seeds for Kashi Vishesh (H1) and Kashi Anupam (H2) were obtained from ICAR-Indian Institute of Vegetable Research, Varanasi. Two different plant growth regulators with four different concentrations each and control were used as treatments, viz., T_1= Control (No application of plant growth regulator and micronutrients), T_2= GA_3 @ 20 ppm, T_3= GA_3 @ 40 ppm, T_4= GA_3 @ 60 ppm, T_5= GA_3 @ 80 ppm, T_6 = NAA @ 25 ppm, T_7 = NAA @ 50 ppm, T_8= NAA @ 75 ppm, and T_9 = NAA @ 100 ppm in the study. The size of the experimental plot was 4.3 m × 3.0 m. Data were collected from ten randomly selected plants for each plot; viz., plant height, number of branches/plant, fruit set percent, number of fruit/plant, average fruit weight, fruit length, fruit width, pericarp thickness and fruit yield/hectare. The values of all characters in the study were subjected to statistical analysis of variance. The determination of the difference between the treatment mean at 0.05 levels of probability was done. A critical difference (CD) at 5% was worked out for the interpretation of the results (Panse & Sukhatame, 1985).

Plant growth parameters, i.e., plant height and number of branches/plant were significantly different in varieties (Table 1). Plant growth regulators like GA_3 and NAA showed promising results concerning the growth and yield of the crop. The response of PGR varies with the species of plant, type of chemical and its concentration. These plant growth regulators induce various physiological impacts. Plant height was increased due to GA_3 @ 80ppm at every successive stage of plant growth. The maximum plant height was found to be 85.5 cm (H1) and 74.80 cm (H2) at 60 DAT with T_5 treatments (GA_3 80 ppm). The level of NAA application brought about a significant increase in plant height at all stages of growth. The increasing level of NAA significantly increased the height of plant at 15, 30, 45 and 60 days of transplanting. At all these stages of plant growth, the maximum plant height, *i.e.*, 82.5 cm (H1) and 70.80 cm (H2) was recorded under the supply of 100 ppm NAA. In contrast, the lowest plant height was recorded in absolute control. The data indicated that the plant height increased at higher concentrations of growth-regulating substances (Rai et al., 2006; Naeem et al., 2006). GA_3 proved to be beneficial and increased the number of branches/plant significantly over control. The data recorded after 30, 45 and 60 DAT showed significant improvement due to GA_3. The maximum number of branches/plant (8.20-H1 and 7.80-H2) was found at 80 ppm GA_3 concentration after 60 DAS, whereas it was only (4.90- H1 and 4.70- H2) cm in control. As far as the effect of NAA application was concerned, it is quite obvious from the data that with the increasing levels of NAA there was a significant increase in the number of branches/plant up to a level of 100 ppm NAA. The number of branches per plant at 100 ppm NAA was as high as (7.9) but without the application of NAA the number of branches/plant fell to a level of 4.9. Number of branches was not influenced by the growth regulatory substances (Balaguera Lolez, 2009). In the present experiment, the significant effect of GA_3 and NAA on plant height and number of branches was recorded. This might be due to a rapid increase in cell division and cell elongation in the meristematic region.

Endogenous hormones largely govern the flowering and fruiting processes. The result clearly shows that fruiting and yield parameters such as percent fruit set, number of fruit/plant, average fruit weight, fruit length, fruit width, number of locules/fruit, pericarp thickness, and fruit yield/ha increased with the application of GA_3 and NAA (Table 2). A perusal of the data indicates that the application of plant growth regulators significantly influenced the percent fruit set/plant. The maximum percent of fruit set was recorded with the treatment *i.e.* T_5 GA_3 @ 80 ppm (51.8%-H1 and 48.60%- H2), which was at par with T_9 NAA @ 100 ppm (49.3%-H1 and 45.20%-H2) In contrast, the minimum percent of fruit set/plant was recorded under control (30.8%-H1 and 26.20%- H2). Thus, the application of GA_3 and NAA spray at

Table 1: Plant growth attributes of tomato varieties affected by GA_3 and NAA

Treatment	*Plant height (cm)*								*Number of branches/plant*					
	15 DAT		*30 DAT*		*45 DAT*		*60 DAT*		*30 DAT*		*45 DAT*		*60 DAT*	
	H1	*H2*	*H1*	*H2*	*H1*	*H2*	*H1*	*H2*	*H1*	*H2*	*H1*	*H2*	*H1*	*H2*
T1	18.00	16.80	23.60	22.20	29.60	26.20	56.40	41.00	1.50	1.40	2.60	2.30	4.90	4.70
T2	23.40	21.00	31.20	27.40	37.40	36.20	62.80	53.40	1.80	1.60	3.20	3.00	5.40	5.10
T3	26.60	22.20	35.00	31.20	47.80	44.70	65.40	56.10	2.20	2.10	3.90	3.60	6.90	6.50
T4	34.60	29.60	42.00	36.20	50.40	39.40	76.00	66.60	3.00	2.80	4.40	4.20	7.60	7.30
T5	38.30	35.40	50.20	42.00	58.30	51.90	85.50	74.80	3.90	3.70	5.00	4.60	8.20	7.80
T6	21.40	20.20	28.80	25.60	37.40	33.10	60.40	48.20	1.60	1.30	2.70	2.50	5.20	4.80
T7	26.00	25.80	30.60	27.40	48.00	34.50	64.80	51.70	2.20	1.90	3.60	3.30	6.50	6.20
T8	32.80	30.60	44.00	36.80	54.50	47.60	74.30	62.70	2.90	2.60	4.20	4.00	7.30	7.00
T9	37.40	31.40	46.20	40.80	57.50	51.80	82.50	70.80	3.50	3.10	4.90	4.50	7.90	7.50
CD at 5%	1.40	1.42	1.47	1.40	1.44	1.38	0.61	0.32	0.69	0.22	0.10	0.07	0.31	0.54

H1: Kashi Vishesh, H2: Kashi Anupam

Table 2: Yield attributes of tomato varieties affected by GA_3 and NAA

Treatments	Fruit set %		Number of fruits		Average fruit weight (gm)		Fruit length (cm)		Fruit width (cm)		Number of locules		Pericarp thickness (cm)		Fruit yield (q/ha)	
	H1	H2	H1	H2	H1	H2	H1	H2	H1	H2	H1	H2	H1	H2	H1	H2
T1	30.80	26.20	13.40	11.80	80.70	77.20	4.50	4.32	4.60	4.40	4.30	4.10	0.60	0.54	380.90	362.20
T2	35.60	33.80	18.90	17.20	85.30	83.70	5.00	4.80	5.12	5.02	4.40	4.30	0.65	0.61	425.30	390.80
T3	40.40	37.10	22.90	20.10	120.40	114.10	5.26	5.16	5.41	5.20	4.60	4.20	0.68	0.60	448.50	415.10
T4	47.50	44.50	26.40	23.80	125.90	118.60	6.12	6.02	6.40	6.08	4.80	4.40	0.72	0.66	466.20	432.30
T5	51.80	48.60	30.40	27.30	131.00	124.40	6.66	6.56	7.06	6.94	5.70	5.30	0.76	0.71	483.80	452.60
T6	32.30	30.30	18.07	16.60	84.30	81.30	4.80	4.64	4.92	4.66	4.20	4.00	0.64	0.58	416.80	398.40
T7	37.90	34.90	21.90	20.40	118.40	109.50	5.02	4.86	5.10	5.01	4.40	4.10	0.65	0.57	447.10	405.30
T8	44.70	41.00	23.60	22.50	122.00	114.90	5.98	5.68	6.31	6.11	4.70	4.50	0.70	0.63	463.70	428.50
T9	49.30	45.20	24.90	21.70	128.80	121.80	6.28	6.10	6.58	6.38	5.60	5.40	0.75	0.71	474.40	459.70
CD at 5%	1.54	1.51	1.48	1.33	1.94	1.32	0.28	0.55	0.3	0.68	0.29	0.69	0.11	0.07	2.98	1.84

H1: Kashi Vishesh, H2: Kashi Anupam

different concentrations showed a significant difference in increasing the percent of fruit set/plant over control. The percent fruit set increased with the application of GA_3 and NAA. It is due to the fact that the application of GA_3 and NAA causes the flowers and fruit to drop and ultimately increase the percent of fruit set (Rodrigues et al., 2001). The application of GA_3 and NAA significantly increased the number of fruits/plant. The increasing number of fruits/plant by GA_3 and NAA treatments might be due to the rapid and better nutrient translocation from roots to apical parts of the plant (Bhosle et al., 2002).

The size and weight of fruit is also important aspects as these fruit characteristics are useful for yield as well as consumer acceptability. Plant growth regulators significantly increased the average fruit weight, length of fruit and width of fruit like GA_3 and NAA. It is due to the application of NAA and $GA_{3,}$ which causes stimulation of fruit growth that results in increased fruit weight, fruit length and fruit width (Ayub & Rezende, 2010). The number of locules/fruit and pericarp thickness increased with an increase in the concentration of GA_3 and NAA, causing an increased supply of photosynthetic materials and its mobilization efficiently in plants, giving rise to an increase in a number of locules/fruit and pericarp thickness of fruit (Bhosle et al., 2002). The fruit yield/hectare significantly increased with the application of NAA and GA_3 as compared to the control. The increase in concentration of GA_3 and NAA resulted in increasing fruit yield. The possible reason for the increase in fruit yield/hectare is due to an increase in the number of fruits/plant, average fruit weight and fruit yield/plant (Soha et al., 2009).

In conclusion, the variety Kashi Vishesh produced higher values of most of the growth and yield attributing characters and resulted in significantly higher fruit yield than that of Kashi Anupam. The foliar application of GA_3 (80 ppm) followed by NAA (100 ppm) showed plant growth and fruit yield traits of tomato. Thus, this study showed a combination of GA_3 (80 ppm) and NAA (100 ppm) in the variety Kashi Vishesh was found to be the best with respect to plant growth and fruit yield.

References

Ayub, R. A., & Rezende, B. L. L. (2010). Gibberellic acid contribution to tomato fruit size. [Portuguese] Biotemas, 23(4), 25-28.

Balagura Lopez H. E., & Cardenas Hernandez, J. F. (2009). Effect of gibberellic acid (GA_3) on seed germination and growth of tomato (*Solanum lycopersicum* L.). Acta Horticulture, 821, 141-147.

Bhosle, A. B., Khrbhade, S. B., Sanap, P. B., & Gorad, M. J. C. (2002). Effect of growth hormones on growth, yield of summer tomato (*Lycopersicon esculentum* Mill.). Orissa Journal of Horticulture, 30(2), 63-65.

Naeem, M., Khan, M. M. A., Gautam, C., Mohmmad, F., Siddiqui, M. H., & Khan, M. N. (2006). Effect of gibberellic acid spray on performance of tomato. Turkish Journal of Biology, 30(1), 11-16.

Pal, G., Roy, S., Singh, N., Singh, P.M, Yerasu, S.R., Yadava, R.B., Behera, T.K.(2023). A study on economic impact assessment of tomato var. Kashi Aman using the economic surplus model. Vegetable Science 50 (1), 46-51.

Panse, V. G., & Sukhatme, P. V. (1985). Statistical methods for agricultural workers. (3rd Ed.). ICAR, New Delhi.

Rai, N., Yadav, D. S., Patel, K. K., Yadav, R. K., Asati, B. S., & Chaubey, T. (2006). Effect of plant growth regulators on growth yield and quality of totamo (*Solanum lycopersicon* (Mill.) Wettsd.) grown under mid hill of Meghalaya. Vegetable Science, 33(2),180-182.

Rodrigues, M. J., Warade, S. D., & Patil, S. D. (2001). Effect of growth regulators and truss sequence on hybrid seed yield of tomato hybrid. Advances in Plant Sciences, 4(2), 495-499.

Singh, B. K., Pathak, K. A., Ramakrishna, Y., Verma, V. K, & Deka, B. C. (2013). Vermicompost, mulching and irrigation level on growth, yield and TSS of tomato (*Solanum lycopersicum* L.). Indian Journal of Hill Farming, 26(2), 105-110.

Singh, U., Patel, P. K., Singh, A. K., Tiwari, V., Kumar, R., Rai N, Bahadur, A., Tiwari, S. K., Singh, M., & Singh, B. (2015). Screening of tomato genotypes under high temperature stress for reproductive traits. Vegetable Science, 42(2), 52-55.

Soha, P., Das, N., Deb, P., & Suresh, C. P. (2009). Effect of NAA and GA_3 on yield and quality of tomato (*Lycopersicon esculentum* Mill). Environment and Ecology, 27(3), 1098-1050.