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Effect of Plant Growth Regulator on Growth, Yield & Quality of Tomato (*Solanum lycopericum*) Cultivar 'Shivaji' under Punjab Condition

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A B S T R A C T

The present investigation was carried out at the Experimental Farm of the School of Agriculture of Lovely Professional University, Phagwada, Jalandhar, during 2016-2017 to find out the effects of plant growth regulators on growth and yield of tomato cultivar 'Shivaji'. The experiment was laid out in Completely Randomized Design having ten treatments and three replications. Treatments consist of different levels of GA_3 (25, 50 and 75 ppm), NAA (25, 50 and 75 ppm) and Kinetin (25, 50 and 75 ppm) along with control. These different concentrations of GA_3, NAA and Ki were sprayed on the crop at 7, 14 and 21 days after transplanting to study the growth behavior and yield attributes of tomato. All growth, phonological as well as yield parameter was found to be significantly superior at different concentration of GA_3, NAA and Ki as compare to control treatment. Maximum plant height (104.33 cm), number of leaves per plant (64.73) and number of branches per plant (11.20) at 90 days after transplanting, minimum days to 50 % flowering (44.40 days), maximum numbers of flower per plant (61.00), fruit length (6.10 cm), fruit diameter (5.93 cm), number of fruit per plant (30.80), fruit yield per plant (3.66 kg) and fruit yield per ha (1355.56 tonnes) was reported in treatment where plant has been sprayed with 50 ppm GA_3.

Introduction

Tomato (*Lycopersicon esculentum* Mill), belongs to Solanaceae family. It is a diploid species with 2n=24 chromosomes. It is native to Peru, Mexico and is cultivated all over the country due to its wider adaptability to soil and climate (Gerszberg *et al.*, 2015). The leading tomato producing countries of the world are China, United States of America, India, Egypt, Turkey, Iran, Mexico, Brazil and Indonesia [FAO, 2016]. In India, at present the total area under tomato cultivation is 799 thousand hectare and production is 19542 thousand MT (NHB, 2016). Top ten state for tomato production in India are; Madhya Pradesh, Andhra Pradesh, Karnataka, Telangana, Gujarat, Orissa, West Bengal, Bihar, Maharashtra and Chhattisgarh (APEDA, 2016). In 2016, India has exported tomato with a worth of value $76.1 million. India is one of the fastest-growing tomatoes exporters since 2012 (Daniel Workman, 2016). Tomato is a rich source of minerals and vitamins. It is frequently referred as 'the poor man's orange' because of its high vitamin,

malic acid and citric acid contents. The attractive red colour of the fruit is due to pigment lycopene. This pigment appears to act as an antioxidant. It neutralizes free radicals in the cells. Free radicals are known to cause cancer, therefore tomato consumption reduce the damage to the cells in the body (Bhowmik *et al.*, 2012). Plant growth regulators (PGRs) are used extensively in crop production to improve plant growth and yield by increasing fruit set, fruit number and weight (Batlang, 2008). They play significant roles in the development of tomato fruit (Srivastava and Handa, 2005). Use of plant growth regulators had improved the production of tomato and other vegetables in respect of better growth and yield (Saha, 2009). Auxins are identified to affect parthenocarpy, fruit setting and fruit size (Matlob and Kelly, 1975; Rappaport, 1957; Osborne and Went, 1953). The key auxin produced by plants is indole-3-acetic acid (IAA). GA_3 is one of the important growth stimulating hormones which enhance cell division and cell elongation thus help in the growth and development of plants. GA_3 increases the leaves size, stem length and fruit set (Serrani *et al.,* 2007). Cytokinins (CKs) are important plant hormones which are known to be key regulators of various aspects of plant growth and development, including cell division, leaves senescence, lateral stem and root formation, stress tolerance and nutritional signaling (Argueso *et al.,* 2009).

Keeping the above circumstance in view, the present study was under taken to evaluate the performance of GA_3, NAA, Kinetin on Growth & yield attributes and determine the optimum concentration of these Plant Growth Regulator in order to maximize the yield of Tomato cultivar 'Shivaji'.

Materials and Methods

The present investigation was carried out at the Experimental Farm of the School of Agriculture of Lovely Professional University, Phagwara, Jalandhar, during 2016-2017 to find out the effects of plant growth regulators on growth and yield of tomato cultivar 'Shivaji'. The experiment was laid out in Completely Randomized Design having ten treatments and three replications. Treatments consist of different levels of GA_3 (25, 50 and 75 ppm), NAA (25, 50 and 75 ppm) and Kinetin (25, 50 and 75 ppm) along with control.

Nursery was shown on 8th March, 2016 and seedlings are transplanted on 4th April, 2016 at distance of 45cm× 60cm. Well rotten FYM @ 4 q was added at the time of field preparation. Basal dose of NPK @ 15:10:12 kg per plot was applied at the time of field preparation. The first dose of urea was applied before transplanting in prepared beds with full amount of single super phosphate and murate of potash. The remaining does of urea was applied at 45 days after transplanting and first fruit picking.

Solution of different level of GA_3, NAA and Ki was prepared according to treatment. The first spray was done after 7 days of transplanting and subsequently two sprays were done at 7 days intervals. Four randomly selected plants in each plot were tagged for observations.

The data on growth parameters like plant height and total numbers of leaves per plant of four tagged plants in each plot were noted at 30, 50, 70 and 90 days after transplanting. Total numbers of branches per plant was recorded at 90 day after transplanting.

The data in phenological characters and yield attributes like days to 50% flowering, total number of flower per plant, fruit diameter, fruit length, number of fruit per plant, fruit yield per plant of four tagged plants in each plot were noted at the time of harvesting.

Results and Discussion

The data on vegetative, phenological and yield attributes *i.e.* plant height, total number of leaves per plant, total number of branches per plant, days to 50% flowering, total number of flowers per plant, fruit length, fruit diameter, total number of fruit per plant, yield per plant was significantly influenced by different types of plant growth regulator. Data of growth and yield parameter is presented in table 1 and 2.

Treatment T2 (GA3 @ 50 ppm) produced significantly tallest plant and maximum numbers of leaves per plant at 30, 50, 70 and 90 days after transplanting (Fig. 1 and Fig. 2). Treatment T2 (GA3 @ 50 ppm) produced significantly tallest plant (104.3 cm), maximum numbers of leaves per plant (64.73) and maximum number of branches per plant (11.20) as compare to all other treatment at 90 days after transplanting.

Minimum plant height (94.03cm), minimum number of branches per plant (8.62) and total number of leaves per plant (58.26) was reported in treatment T10, where plant has not given any plant growth regulator treatment. Effect of treatment T3 (GA3 @75) & treatment T6 (NAA @75) on plant height was found to be spastically at par with each other. Plant height in these two treatments was recorded as 97.16cm and 97.23cm respectively at 90 days after transplanting.

Effect of kinetic @25ppm (T_7) and 50ppm (T_8) on plant height was found to be statistically at par with each other. Plant height in these two treatments was recorded as 96.46cm & 96.50cm respectively at 90 days after transplanting. Treatment T3 (GA_3 @ 75 ppm) and treatment T6 (NAA@ 75 ppm) was found to be statically at par with each other in term of their effect on number of leaves per plant. Total number of leaves per plant in these treatments at 90 days after transplanting was recorded as 61.70 and 61.60 respectively. Similarly effect of application of lower dose of GA_3 @ 25ppm (T_1) and higher level application of kinetin @75 ppm (T_9) was found to be significantly at par with each other.

The number of leaves per plant in these treatments was reported as 61.20 and 61.03 respectively at 90 days after transplanting. Effect of application of GA_3 @25ppm (T_1), 75 ppm (T_3), NAA @ 50ppm (T_5), 75 ppm, Kinetin @ 75 ppm (T_9) on number of branches per plant was found to be statistically at par with each other.

Number of branches per plant in these treatments was recorded as 9.06, 9.06, 9.06, 8.83, 8.64, 8.62 respectively. Maximum plant height, number of leaves per and number of branches per plant has been found in treatment T_2 (GA_3 @ 50ppm), this may be due to the role of GA_3 in increasing cell division and cell elongation. Same finding has been reported by Prasad *et al.,* (2013), Kumar *et al.,* (2014) and Chauhan *et al.,* (2017).

In phenological character, minimum days to 50 % flowering (44.40) and maximum numbers of flower per plant (61.00) was reported in treatment T_2 (GA_3 @ 50 ppm), which was found to be statistically superior to all other treatment. Maximum number of days to 50 % flowering (55.93), minimum number of flowers per plant (43.00) was reported in treatment T_{10} where plant has not given any plant growth regulator.

Treatment T_2 (GA_3@ 50ppm) was found to be statistically superior than all other treatment, this may be due to the role of this growth stimulating hormones to complete the shortage of natural growth substances require for cell division and cell elongation. The present finding also agreed to the result of Bhalekar *et al.,* (2006), Rahman *et al.,* (2015).

Table.1 Effect of different types of plant growth regulator on plant height, number of leaves per plant, number of branches per plant at 90 days after transplanting in tomato cultivar 'Shivaji' under Punjab condition

Treatment No.	Plant Height (cm)	Number of leaves per plant	Number of branches per plant
T1 (GA_3@ 25ppm)	99.00^{b}	61.20 ^{d}	9.06 ^{d}
T2 (GA_3@ 50ppm)	104.33^{a}	64.73 ^{a}	11.20^{a}
T3 (GA_3@ 75ppm)	97.16^{cd}	61.70^{cd}	9.06 ^{d}
T4 (Auxin@ 25ppm)	98.56^{bc}	63.20^{b}	9.83^{bc}
T5 (Auxin@ 50ppm)	97.80^{bcd}	62.60 ^{bc}	9.06^{d}
T6 (Auxin@ 75ppm)	97.23^{cd}	61.60^{cd}	8.83^{d}
T7 (Kinetin@25ppm)	96.46^{d}	62.00^{bcd}	10.40^{b}
T8 (Kinetin@ 50ppm)	96.50^{d}	62.03^{bcd}	9.36^{cd}
T9 (Kinetin @ 75ppm)	94.86^{e}	61.03 ^{d}	8.69^{d}
T10 (Control)	94.03^{e}	58.26 ^{e}	8.62^{d}
C.D.	1.49	0.78	0.74

Analysis of variance (one-way ANOVA) was used to determine which variables were significant (P = 0.01 level). Web Based Agricultural Statistics Software was used to test the significant differences among levels of treatment. Data followed by different letters are significantly different at 5 % level of significance.

Table.2 Effect of different type of plant growth regulator on days to 50% flowering, total number of flowers per plant, fruit length, fruit diameter, total number of fruit per plant and yield per plant in tomato cultivar 'Shivaji' under Punjab condition

Treatment No.	Days to 50% flowering	Number of flowers per Plant	Fruit length (cm)	Fruit diameter (cm)	Number of fruit per plant	Yield per plant (kg)
T1 (GA_3@ 25ppm)	53.46^{bc}	47.66 ^{bc}	4.83^{d}	4.33^{d}	25.83^{cd}	1.46 ^{de}
T2 (GA_3@ 50ppm)	44.40^{f}	61.00 ^{a}	6.10^{a}	5.93^{a}	30.80 ^{a}	3.66 ^{a}
T3 (GA_3@ 75ppm)	49.33^{d}	50.66 ^{b}	5.70^{b}	4.90^{b}	27.10 ^{bc}	1.93^{bcd}
T4 (Auxin@ 25ppm)	47.90^{e}	51.00 ^{b}	5.66^{b}	5.30^{b}	26.50^{b}	2.20^{b}
T5 (Auxin@ 50ppm)	52.60 ^{c}	49.00 ^{bc}	4.66^{de}	4.96^{c}	26.50^{b}	1.76^{bcde}
T6 (Auxin@ 75ppm)	54.10 ^{b}	48.33 ^{bc}	4.66^{de}	4.36^{d}	25.66^{cd}	1.30^{e}
T7 (Kinetin@25ppm)	49.80 ^{d}	45.66 ^{cd}	5.20^{c}	5.13^{bc}	25.8 ^{cd}	2.03^{bc}
T8 (Kinetin@ 50ppm)	53.20^{bc}	48.00 ^{bc}	4.86^{cd}	4.83^{c}	26.03 ^{cd}	1.86^{bcd}
T9 (Kinetin@ 75ppm)	53.13^{bc}	49.33^{b}	4.93^{cd}	4.33^{d}	26.16^{cd}	1.63 ^{cde}
T10 (Control)	55.93^{a}	43.00 ^{d}	4.36^{e}	4.16^{d}	22.93^{e}	1.26 ^{e}
C.D.	**1.16**	**4.88**	**0.34**	**0.30**	**1.65**	**0.56**

Analysis of variance (one-way ANOVA) was used to determine which variables were significant (P = 0.01 level). Web Based Agricultural Statistics Software was used to test the significant differences among levels of treatment. Data followed by different letters are significantly different at 5 % level of significance.

Fig.1 Effect of different types of plant growth regulator on plant height of tomato cultivar 'Shivaji' at successive growth stages

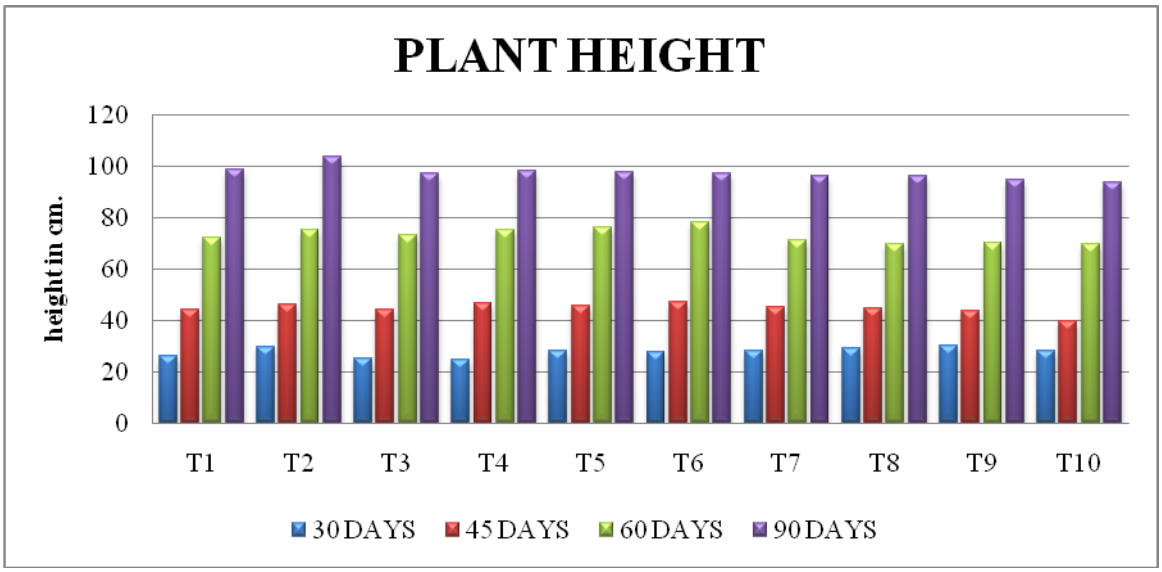
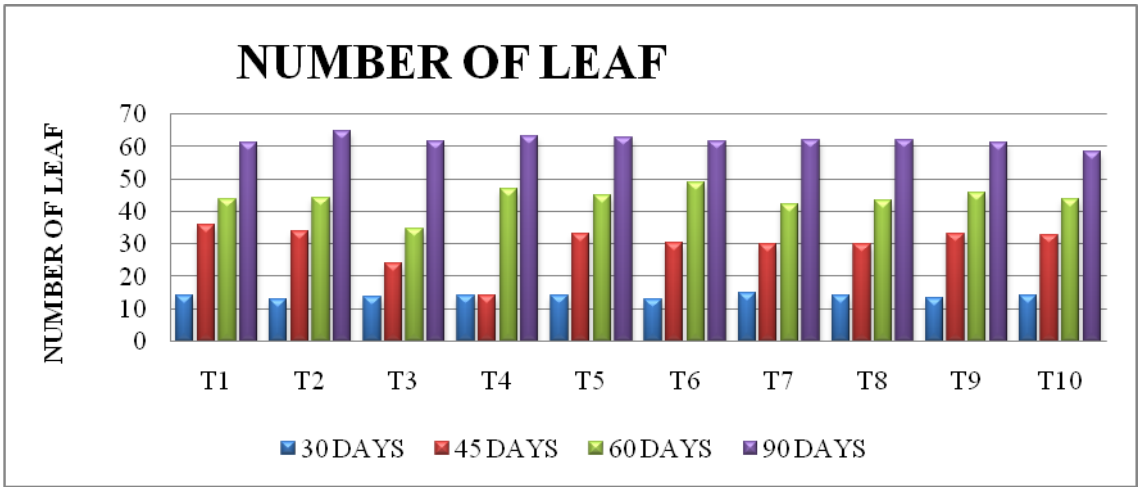


Fig.2 Effect of different types of plant growth regulator on number of leaves per plant of tomato cultivar 'Shivaji' at successive growth stages



In yield attributes, maximum fruit length (6.10 cm), fruit diameter (5.93 cm) number of fruit per plant (30.80) and yield per plant (3.66 kg) was reported in treatment T_2 (GA_3 @ 50 ppm). This treatment was found to be statistically superior to all other treatment. Minimum fruits length (4.36cm), fruit diameter (4.16cm), number of fruit per plant (22.93) and yield per plant (1.26 kg) was reported in treatment T_{10} where plant has not given any plant growth regulator. Effect of treatment T_3 (GA_3 @75 ppm) and treatment T_4 (NAA @25 ppm) on fruit length was found to be statistically at par with each other. Fruit length in these treatments was recorded as 5.70cm and 5.66cm respectively. Effect of treatment T_1 (GA_3 @25 ppm), treatment T_6 (NAA @75 ppm), treatment T_9 (Kinetin @ 75 ppm) and treatment T_{10} (control) on fruit diameter was found to statistically at par with

each other. Fruit diameter in these treatments was recorded as 4.33cm, 4.36cm, 4.33cm and 4.16cm respectively. Effect of treatment T_1 (GA_3 @25 ppm), T_6 (NAA @75 ppm), T_7 (Kinetin @25 ppm) and T_8 (Kinetin @ 50ppm) on number of fruit per plant was found to be statistically at par with each other. Total number of fruits per plant in these treatments was recorded as 28.83, 25.66, 25.8, 26.06 and 26.16 respectively. Application of GA_3 @ 50 ppm was found to be superior for the entire yield attribute; this may be due to the role of this growth stimulating hormones for enhancing pollen germination, fertilization, fruit set, cell division and elongation after pollination. The present finding also agreed to the result of Ram *et al.*, (2014), Kumar *et al.*, (2014), Rahman *et al.*, (2015).

From these results, it may be inferred that the application of GA_3 @50 ppm may be adopted to enhance the productivity of tomato.

References

APEDA. 2016. The Agriculture and Processed Food product Export Development Authority. Govt. of India. http://agriexchange.apeda.gov.in/Market%20Profile/one/TOMATO.aspx

Argueso, C.T., Ferreira, F.J. and Kieber, J.J. 2009. Environmental perception avenues the interaction of cytokinin and environmental response pathways. Plant Cell and Environment, 32: 1147–1160.

Batlang, U. 2008. Benzyladenine plus gibberellins (GA4+7) increase fruit size and yield in greenhouse-grown hot pepper (*Capsicum annuum* L.). Journal of Biological Science, 8(3): 659-662.

Bhowmik, D., Kumar, K.P.S., Paswan, S. and Srivastava, S. 2012. Tomato-a natural medicine and its health benefits. Journal of Pharmacognosy and Phytochemistry, 1(1): 2278-4136.

Chauhan, S.A., Patel, N.B., Mehta, D.R., Patel, J.B., Zala, I.M. and Vaja, A.D. 2017. Effect of plant growth regulator on seed yield and its parameters in tomato (*Solanum lycopersicon* L.). International Journal of Agriculture Sciences, 9(8): 3906-3909.

Daniel workman 2016. http://www.worldstopexports.com/tomatoes-exports-country/

FAO. 2016. The Food and Agriculture Organization of United Nations. http://www.fao.org/faostat/en/#data/QC

Gerszberg, A., Katarzyna, H.K., Kowalczyk, T. and Kononowicz, A.K. 2015. Tomato (*Solanum lycopersicum* L.) in the service of biotechnology. Plant Cell Tiss Organ Cult, 120: 881–902.

Kumar, A. T. K, Singh, N. and Dr.Lal, E. P. 2014. Effect of Gibberellic Acid on Growth, Quality and Yield of Tomato (*Lycopersicon esculentum* Mill.). *Journal of Agriculture and Veterinary Science*, 7(7): 28-30

Matlob A.N. and Kelly W. C. 1975. Growth regulator activity and parthenocarpic fruit production in snake melon and cucumber grown at high temperature. Journal of American Society of Horticulture Science, 100: 406- 409.

NHB. 2016. National Horticulture database. National Horticulture Board. Govt. of India, Gurgaon, India. http://www.nhb.gov.in.

Prasad, R.N., Singh, S.K., Yadava, R.B. and Chaurasia, S.N.S. (2013). Effect of GA3 and NAA on growth and yield of tomato. Vegetable Science, 40 (2): 195-197.

Rahman, M. S., Haque, M. A. and Mostofa, M. G. 2015. Effect of GA3 on Biochemical Attributes and Yield of Summer Tomato. Journal of Bioscience and Agriculture Research, 03(02): 73-78.

Ram, R. B., Prakash, J. and Meena, M. L. (2014). Growth, flowering, fruiting, yield and quality of tomato (*Lycopersicon esculentum* Mill.) as influenced plant bio regulators. International Journal of Plant Sciences (Muzafparnagar), 9(1): 6771.

Saha, P. 2009. Effect of NAA and GA3 on yield and quality of tomato (*Lycopersicon esculentum* Mill). Environ. & Ecol, 27(3): 1048-1050.

Serrani, J.C., Fos, M., Atare´s, A. and Garcı´aMartı´nez, J.L. 2007. Effect of gibberellin andauxin on parthenocarpic fruit growth induction in the cv MicroTom of tomato. J. Plant Growth Regul, 26: 211-221

Srivastava, A. and Handa, A.K. 2005. Hormonal regulation of tomato fruit development: a molecular perspective. *J Plant Growth Regul*, 24: 67–82.

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