International Journal of Science and Research (IJSR)
ISSN: 2319-7064
ResearchGate Impact Factor (2018): 0.28 | SJIF (2018): 7.426

Studies on the Effect of Different Plant Growth Regulators on Growth and Quality Attributes of Tomato (*Solanum lycopersicum* L.) Cv. Kashi Amrit

Yamini Siwna[1], Amit Dixit[2], Tikesh Kumar Sahu[3]

[1, 2, 3]Department of Vegetable Science, IGKV, Raipur - 492012 (C.G.), India

Abstract: ***The present investigation was undertaken to "Studies on the effect of different plant growth regulators on growth and quality attributes of tomato (Solanum lycopersicum L.) cv. Kashi Amrit" Horticulture cum instructional farm in the experimental field of AICRP on vegetable crops, College of Agriculture, IGKV, Raipur (C.G), during 2018-19. The experiment was laid out in Completely Randomized Design having of ten treatment and three replication. All growth, phonological as well as yield and quality parameters was found to be significantly superior at different concentration of GA_3, NAA and Kinetin as compare to control treatment. The data clearly showed that the maximum plant height (84.54 cm), number of leaves per plant (35.67), number of branches in per plant (16.34), plant girth (4.64 cm) at 90 days after transplanting, minimum days required to first flowering (25.67), days to first fruiting (32.34) and minimum days to maturity (63.33), maximum no. of total soluble solid (4.74^{0}Brix), acidity (0.42%), ascorbic acid (18.44mg/100) was reported in treatment where plant has been sprayed with GA_3 (50ppm).***

Keywords: Tomato, Plant growth regulators, Growth and Quality parameters

1. Introduction

Tomato (*Solanum lycopersicum* L.) is an important vegetable crop belonging to the family Solanaceae, which has tremendous popularity during the last century. It is a tropical day and a certain percentage of cross-pollinated also occurs. The crop is native to Central and South America (Vavilov, 1951). In a natural manner, it lives more than two years but can be cultivated as an annual crop. Because of having an immense economic and advantages it is cultivated widely. Moreover, tomato is considered as the second greatest consequential vegetable crop in the world after potato. A top the last century, tomato *[Lycopersicon esculentum* Mill.] as an important vegetable crop, has attained massive popularity. When we make use of plant growth regulator in tomato has been found valuable for growth, yield, quality, earliness, and cold, high-temperature fruits setting and to build up resistance to TLCV. Soaking of seed earlier than sowing in GA_3 (0.5ppm) or 2,4-D(0.5ppm) enhances the germination of seed. Plant growth regulators (PGR's) are used widely in crop production to improve plant growth and yield by increasing fruit set, fruit no. and weight (Batlang, 2008). They play important roles in the enlargement of tomato fruit (Srivastava and Handa, 2005). Use of plant growth regulators had enhanced the production of tomato and other vegetables in reverence of better growth and yield (Saha, 2009). Auxins are recognized to affect parthenocarpy, fruit setting and fruit size (Matlob and Kelly, 1975).

The key important hormone is auxin produced by plants is indole-3-acetic acid (IAA). GA3 is one of the remarkable growth-stimulating hormones and cell division and cell elongation thus it helps in the growth and development of plants. GA3 increases leave size, stem lengths and fruit sets (Serrani *et al*., 2007). Cytokinins (CKs) are vital plant hormones that are known to be key regulators of various aspects of plant growth and development, including cell division, leaves senescence, lateral stem and root conformation, stress tolerance and nutritional signalling (Argueso *et al.*, 2009). Keeping the above circumstance in view, the present study is for estimation of the performance of GA_3, NAA, Kinetin on Growth and yield in tomato. Plant growth regulators are a chemical substance with small concentration; they stimulate and regulate the physiological process of the plant. Mostly applied growth regulators is, GA_1, NAA, 4 - CPA, 2, 4-D. It should be applied in less quantity; they are equally efficient and profit-making to the farmer. However, the improvement of the crop differs greatly depending on the type of growth regulators used, concentration, time and application.

2. Material and Methods

A field experiment to "Effect of different plant growth regulators on growth and quality attributes of tomato (*Solanum lycopersicum* L.) cv. Kashi Amrit" was conducted at Research cum Instruction Farm, Department of vegetable Science, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during the Kharif season of 2018-19.

The experiment consisting ten treatments in Randomized Block Design with three replication with 2×1.8 meter plot size and spacing of plant is 60 cm×45 cm (R×P). Treatment consist of different levels of GA_3 (25, 50 and 75ppm), NAA (15, 20 and 25 ppm) and Kinetin (25, 50 and 75 ppm) along with control. The treatment consisted of ten treatments viz., T_1-control (water spray), T_2- GA_3 @ 25 ppm, T_3 - GA_3 @ 50 ppm, T_4 - GA_3 @ 75 ppm, T_5 - NAA @ 15 ppm, T_6 - NAA @ 20ppm, T_7-NAA @ 25 ppm, T_8 - Kinetin @ 25 ppm, T_9 – Kinetin @ 50 ppm, T_{10} – Kinetin @75ppm. These different concentrations of GA_3, NAA and Kinetin were sprayed on the crop. The first foliar application was done at 30 days after planting in the morning hours. The second application at 45 days and the third application at 60 days after planting were done after the wetting agent. The uniform spraying was carried out with the help of the knapsack sprayer, the leaves on both sides were completely wet with the spray solution.

The total amount of solution required to be sprayed on experimental plants was decided by representative tomato plants.

The important parameters encompassed in the research study Plant height (cm) , number of leaves per plant, number of branches per plant, plant girth, days to first flowering, days to first fruiting, days to maturity and quality attributes of tomato. The data collected from five randomly selected plants for above said parameters were subjected to analysis of variance technique (ANOVA) and least significance difference test was applied to separate different treatment means (Panse and Sukhatme, 1967).

3. Result and Discussion

The data on vegetative growth parameters viz. Plant height(cm) , number of leaves per plant, number of branches per plant, plant girth, days to first flowering, days to first fruiting, days to maturity and quality attributes of tomato . This was significantly influenced by the different type of plant growth regulators. Were the data of growth and quality parameter are presented in tables.

Plant height ranged from 84.54 cm (T_3) to 73.97 cm (T_1). Tallest plant height was recorded in the treatment T_3 (GA_3 @ 50 ppm) which may be due to cell elongation and rapid cell division in growing portion, stimulated RNA and there by leading to enhanced growth and development Maity *et al.*, (2016) there are number of reports showing that gibberellins promote growth of intact plants. Minimum plant height (73.97 cm) was recorded for treatment T_1 (control). Variation in plant height may be due to foliar application of GA_3 @ 50 ppm in per ha. (Table 4.1; Fig 4.1).

Number of leaves per plant ranged from 35.67 (T_3) to 25.67 (T_1). Highest no. of leaves was recorded in the treatment T_3 (GA_3 @ 50 ppm); 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). Variation in number of leaves per plant may be due to foliar application of GA_3 @ 50 ppm in per ha. (Table 4.2; Fig 4.2)

No. of branches in per plant ranged from 16.34 (T_3) to 12.67 (T_1). Highest no. of branches in per plant was observed in the treatment T_3 (GA_3); it may be due to the role of GA_3 in increasing cell division and cell elongation which is responsible for vegetative growth of plant.(Table 4.3; Fig 4.3).

Plant girth ranged from (T_3) 4.63 cm to 4.27 cm (T_1). Maximum plant girth was recorded in the treatment T_3 (GA_3 @ 50 ppm) was found to be 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 4.4; Fig 4.4)

Days taken for initiation of first flowering ranged from 25.67 days (T_3) to 32.34 days (T_1). Minimum days was recorded in the treatment T_3 (GA_3 @ 50 ppm) which was founded to be significantly responded in promoting vegetative growth characters conductive to food manufacturing mechanism hence the treated plant have comparatively more food stock that responsible for early flowering Kumar *et al.*, 2017). Maximum days was taken for first flowering 32.34 days was recorded for treatment T1 (control). (Table 4.5; Fig 4.5).

Days taken for initiation of first fruiting ranged from 32.34 days (T_3) to 38.67 days (T_{10}). A minimum day was recorded in the treatment T_3 (GA_3) which was found to be superior to all other treatment. A maximum day was taken for first fruiting 38.67 days was recorded for treatment T_1 (control). (Table 4.5; Fig 4.5).

Days taken for maturity ranged from 63.33 days (T_3) to 76.96 days (T_1). Minimum days of maturity was recorded in the treatment T_3 (GA_3 @ 50 ppm) had earliness of flowering therefore it leads to early maturity of fruits. A maximum day was taken for maturity 76.96 days was recorded for treatment T_1 (control). (Table 4.5; Fig 4.5).

Table 4.1: Effect of plant growth regulator on plant height at 30, 45, 60 and 90 days after transplanting in tomato cultivar 'Kashi Amrit' under field condition

Treatments	Plant height (cm)			
	30 Days	45 Days	60 Days	90 Days
T_1 (Control)	37.34	47.34	62.67	73.97
T_2 (GA_3 @ 25 ppm)	45.64	55.67	67.34	78.16
T_3 (GA @ 50 ppm)	58.67	69.34	71.34	84.54
T_4 (GA @ 75 ppm)	44.67	54.67	66.34	77.82
T_5 (NAA @ 15 ppm)	41.67	52.34	64.67	76.27
T_6 (NAA @ 20 ppm)	44.34	59.67	66.67	77.85
T_7 (NAA @ 25 ppm)	44.67	56.34	65.67	75.86
T_8 (Kinetin @25 ppm)	41.67	52.67	64.67	80.18
T_9 (Kinetin @ 50 ppm)	40.67	52.67	66.34	77.78
T_{10} (Kinetin @ 75 ppm)	41.34	53.34	66.34	79.69
CV (%)	**10.98**	**8.54**	**7.07**	**7. 35**
CD (0.05)	**8.59**	**8.40**	**8.31**	**10.24**
SEm±	**2.79**	**2.73**	**2.70**	**3. 33**

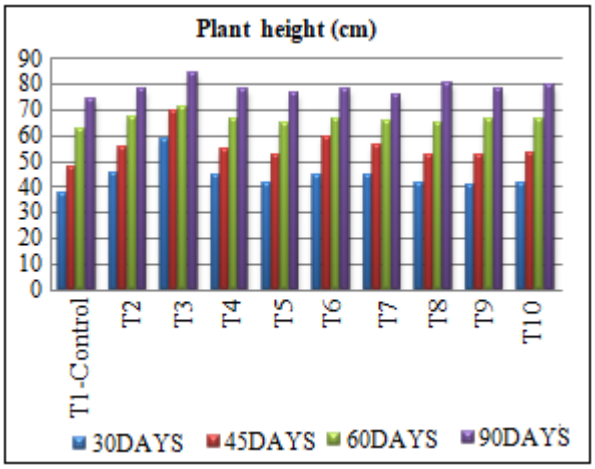

Figure 4.1: Effect of different types of plant growth regulator on plant height of tomato cultivar 'Kashi Amrit' at growth stage

Table 4.2: Effect of plant growth regulator on no. of leaves per plant at 30, 45, 60 and 90 days after transplanting in tomato cultivar 'Kashi Amrit' under field condition:

Treatments	No. of leaves per plant			
	30 Days	45 Days	60 Days	90 Days
T_1 (Control)	6.67	21.67	23.67	25.67
T_2 (GA_3 @ 25 ppm)	7.34	26.67	27.34	29.34
T_3 (GA @ 50 ppm)	9.34	29.67	33.34	35.67
T_4 (GA @ 75 ppm)	7.67	26.67	27.34	29.67
T_5 (NAA @ 15 ppm)	6.34	26.34	27.67	29.34
T_6 (NAA @ 20 ppm)	7.34	26.67	27.34	28.67
T_7 (NAA @ 25 ppm)	7.34	26.67	27.67	30.34
T_8 (Kinetin @25 ppm)	8.34	29.67	29.67	31.67
T_9 (Kinetin @ 50 ppm)	7.34	26.34	27.34	30.34
T_{10} (Kinetin @ 75 ppm)	7.35	25.35	26.67	28.67
CV (%)	**8.81**	**7.75**	**8.91**	**7.67**
CD (0.05)	**1.17**	**3.67**	**4.40**	**10.57**
SEm±	**0.38**	**1.19**	**1.45**	**3.44**

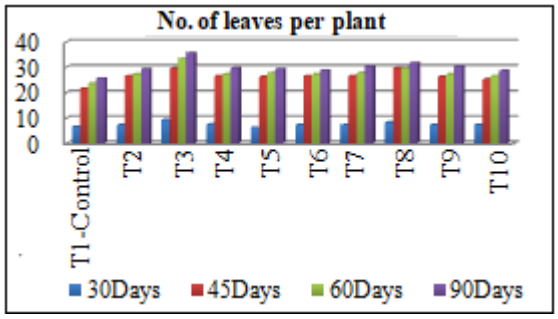

Figure 4.2: Effect of different types of plant growth regulator on no. of leaves per plant of tomato cultivar 'Kashi Amrit' at successive growth stage

Table 4.3: Effect of plant growth regulator on no. of branches per plant at 30, 45, 60 and 90 days after transplanting in tomato cultivar 'Kashi Amrit' under field condition:

Treatments	No. of branches per plant			
	30 Days	45 Days	60 Days	90 Days
T_1 (Control)	5.00	10.34	10.34	12.67
T_2 (GA_3 @ 25 ppm)	6.00	11.67	12.34	14.34
T_3 (GA @ 50 ppm)	7.60	14.11	14.34	16.34
T_4 (GA @ 75 ppm)	6.00	12.67	12.67	14.34
T_5 (NAA @ 15 ppm)	6.60	12.34	11.67	14.34
T_6 (NAA @ 20 ppm)	6.60	11.34	11.34	14.34
T_7 (NAA @ 25 ppm)	7.00	11.34	12.34	15.34
T_8 (Kinetin @25 ppm)	6.60	11.67	12.34	14.34
T_9 (Kinetin @ 50 ppm)	6.00	11.34	11.67	15.67
T_{10} (Kinetin @ 75 ppm)	6.60	12.34	11.67	14.34
CV (%)	**8.08**	**8.31**	**8.33**	**8.43**
CD (0.05)	**0.92**	**1.76**	**1.79**	**2.19**
SEm±	**0.30**	**0.57**	**0.58**	**0.71**

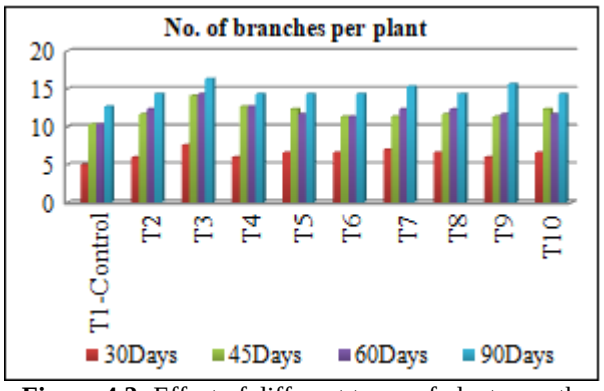

Figure 4.3: Effect of different types of plant growth regulator on no. of branches per plant of tomato cultivar 'Kashi Amrit' at successive growth stage

Table 4.4: Effect of plant growth regulator on plant girth at 30, 45, 60 and 90 days after transplanting in tomato cultivar 'Kashi Amrit' under field condition

Treatments	Plant girth (cm)			
	30 Days	45 Days	60 Days	90 Days
T_1 (Control)	3.24	3.77	4.13	4.27
T_2 (GA_3 @ 25 ppm)	4.03	3.97	4.26	4.37
T_3 (GA @ 50 ppm)	4.43	4.34	4.54	4.64
T_4 (GA @ 75 ppm)	3.67	4.03	4.24	4.37
T_5 (NAA @ 15 ppm)	3.93	4.26	4.24	4.44
T_6 (NAA @ 20 ppm)	3.96	4.03	4.04	4.34
T_7 (NAA @ 25 ppm)	4.03	4.23	4.27	4.44
T_8 (Kinetin @25 ppm)	4.06	4.03	4.17	4.34
T_9 (Kinetin @ 50 ppm)	3.93	4.06	4.24	4.37
T_{10} (Kinetin @ 75 ppm)	4.13	3.93	4.27	4.44
CV (%)	**8.47**	**7.80**	**8.47**	**8.04**
CD (0.05)	**0.60**	**0.56**	**0.64**	**0.63**
SEm±	**0.19**	**0.18**	**0.21**	**0.20**

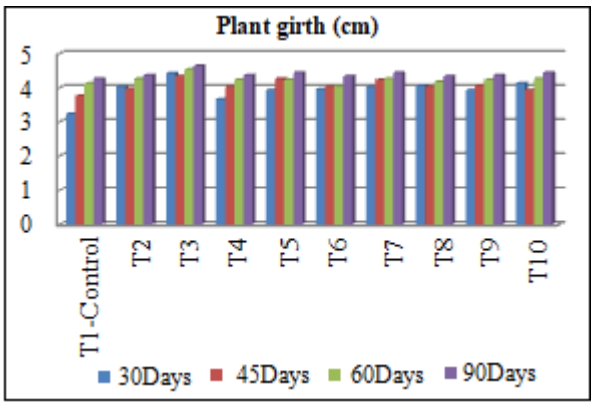

Figure 4.4: Effect of different types of plant growth regulator on plant girth plant of tomato cultivar 'Kashi Amrit' at successive growth stage

Table 4.5 : Effect of plant growth regulator on days to first flowering, days to first fruiting, days to maturity after transplanting in tomato cultivar 'Kashi Amrit' under field condition

Treatments	Days to first flowering	Days to first fruiting	Days to maturity
T_1(Control)	32.34	38.67	76.96
T_2(GA_3@25ppm)	28.34	33.34	68.25
T_3(GA@50ppm)	26.67	32.34	63.33
T_4(GA@75ppm)	28.34	34.34	65.28
T_5(NAA@15ppm)	28.67	34.34	67.75
T_6(NAA@20ppm)	25.67	34.34	68.62

T_7(NAA@25ppm)	28.67	33.67	68.58
T_8(Kinetin@25ppm)	27.34	34.34	69.39
T_9(Kinetin@50ppm)	28.34	35.34	69.41
T_{10}(Kinetin@75ppm)	27.67	33.67	70.38
CV (%)	**9.28**	**7.89**	**8.94**
CD (0.05)	**4.65**	**4.83**	**10.92**
SEm±	**1.51**	**1.57**	**3.55**

Effect of foliar spray of plant growth regulators on the quality attributes of tomato crop.

Total soluble solids content of fruits are ranged from 4.47 ^{0}Brix (T_1) to 4.74 ^{0}Brix (T_3). Highest TSS reading 4.74 (^{0}Brix) was recorded in the treatment T_3 (GA_3 @50 ppm) which may be due to thicker pericarp than pollinated fruits throughout its development and TSS is response to GA_3. Minimum TSS 4.47 ^{0}Brix (T_1) was recorded for treatments (T_1). All treatments are found non-significant. Variation in TSS may be due to foliar application of GA_3 @ 50 ppm in per ha. (Table 4.6; Fig 4.6).

Acidity (%) content of fruits ranged from 0.33 % (T_1) to 0.42 % (T_3). Highest acidity ranged 0.42 % was recorded in the treatment T_3 (GA_3 @ 50 ppm) which may be due there variety and have pH values slightly above (4.6). Minimum Acidity 0.33 % was recorded for treatments (T_1) control. Treatments are T_2, T_4, T_5, T_7, T_{10}, found non-significant that are T_2 (GA_3 @ 25 ppm), T_4 (GA_3 @ 75 ppm), T_5 (NAA @ 15 ppm), T_6 (NAA @ 20 ppm), T_7 (NAA @ 25 ppm), T_8 (Kinetin @ 25 ppm), T_9 (Kinetin @ 50 ppm), T_{10} (Kinetin @ 75 ppm) and, T_1 (control). Variation in acidity (%) may be due to foliar application of GA_3 @ 50 ppm in per ha. (Table 4.6; Fig 4.6)

The Ascorbic acid content of fruits ranged from 17.79 mg/100 (T_1) to 18.44 mg/100 (T_3). Highest ascorbic acid was recorded 18.44 mg/100 was recorded in the treatment T_3 (GA_3 @ 50 ppm) which may be associated with the expression of genes involved in pectin degradation. Minimum ascorbic acid 17.79 mg/100 were recorded for treatments (T_1) control. All treatments found non-significant. Variation in ascorbic acid (mg/100) may be due to foliar application of GA_3 @ 50 ppm in per ha. (Table 4.6; Fig 4.6)

Table 4.6: Effect of plant growth regulator on the quality attributes of tomato cultivar 'Kashi Amrit' under field condition

Treatments	*Total Soluble solid (^{0}Brix)*	*Acidity (%)*	*Ascorbic acid (mg/100g)*
T_1(Control)	4.47	0.33	17.79
T_2(GA_3@25ppm)	4.72	0.41	18.44
T_3(GA@50ppm)	4.74	0.42	18.44
T_4(GA@75ppm)	4.71	0.39	18.41
T_5(NAA@15ppm)	4.50	0.38	18.43
T_6(NAA@20ppm)	4.70	0.36	18.29
T_7(NAA@25ppm)	4.52	0.37	18.40
T_8(Kinetin@25ppm)	4.59	0.35	18.28
T_9(Kinetin@50ppm)	4.52	0.36	18.32
T_{10}(Kinetin@75ppm)	4.64	0.38	18.22
CV (%)	**7.18**	**8.92**	**6.05**
CD (0.05)	**0.59**	**0.06**	**1.97**
SEm±	**0.19**	**0.02**	**0.64**

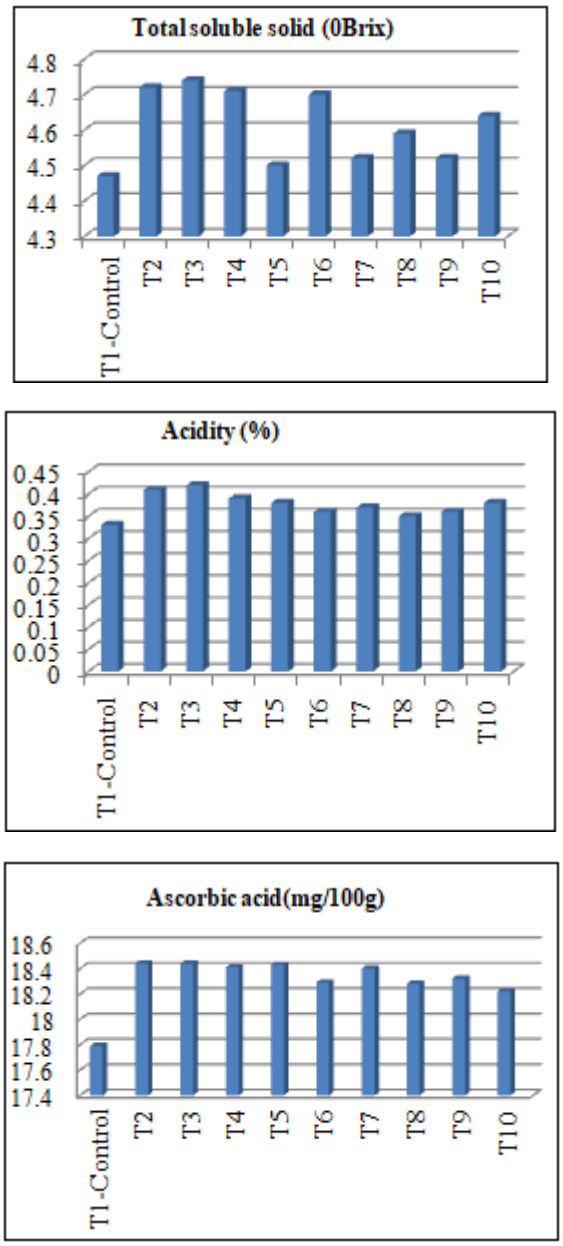

Figure 4.6: Effect of plant growth regulator on total soluble solid (^{0}Brix), acidity (%) and ascorbic acid (mg/100) in tomato cultivar 'Kashi Amit'

4. Conclusion

The application of plant growth regulators are effective response in growth and yield attributes of tomato. The finding revealed that treatment T_3 @ $GA_3$50 ppm recorded the maximum (plant height (cm), number of leaves per plant, number of branches per plant, plant girth (cm) and minimum days taken in (days to first flowering, days to first fruiting, days to maturity) and maximum in quality parameters .

5. Acknowledgments

The authors are thankful to the Department of Vegetable Science, Indira Gandhi Krishi Vishwavidyalaya, Raipur

References

[1] 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.
[2] 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.
[3] 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.
[4] 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.
[5] Daniel workman 2016. http://www.worldstopexports.com/toma toes-exports-country/
[6] FAO. 2016. The Food and Agriculture Organization of United Nations. http://www.fao.org/faostat/en/#data/QC
[7] 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.
[8] 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
[9] 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.
[10] NHB. 2016. National Horticulture database. National Horticulture Board. Govt. of India, Gurgaon, India. http://www.nhb.gov.in.
[11] Panse, V.G. and Sukhatme, P.V. 1967. Statistical methods for agricultural workers. Indian Council of Agricultural Research, New Delhi, India, 152-161 pp
[12] 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): 195197.