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Influence of pre-harvest treatments of gibberellic acid (GA_3) and other chemicals on growth and yield attributing characters of tomato (*Lycopersicon esculentum* Mill.) cv. anand tomato-3

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ABSTRACT : The study was conducted at the main vegetable research station of the Anand Agricultural University, Anand during the period *Kharif* and *Rabi* (2010-11) to determine the effects of different concentrations of GA_3 and chemicals on growth and yield of tomato. The treatments comprised of GA_3 @ (20 and 40mg/l); KNO_3 (2000 and 4000mg/l); $KHCO_3$ (2000 and 4000mg/l); boric acid (100 and 200mg/l) with the control (without spray). The growth and yield contributing parameters differed significantly. The results revealed that the pre harvest treatments of GA_3 @ 40mg/l (T_2) had significant effect on plant height (114.77cm), number of leaves (80.10), branches (12.13) per plant recorded at 75 DATP. Similar trends were also observed for minimized the days required for the breaker stage (78.03days) and the red-ripe stage (86.47days) under the treatment (T_2). It was also observed that the pre harvest treatments of GA_3 @ 40mg/l had significant effect on yield and yield attributing characters *viz.*, number of fruits per plant (30.70) and total yield (384.77q/ha).

Key Words : Boric acid, Gibberellic acid, Growth, Potassium bicarbonate, Potassium nitrate, Tomato,Yield

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Tomato (*Lycopersicon esculentum* Mill.) is one of the most important vegetables crop grown worldwide; belongs to the Solanaceae family and a native to South America. Tomato is a warm season crop reasonably resistant to heat and drought and it is not sensitive to day length and sets fruit in day lengths varying from 7-19 hrs. There is a good market value because of its uses and its nutritious contents.There is increasing evidence that diet can play an important role in human health by providing important substances that increase the body defense system against several diseases. For good fruit set and better yield, pollination, germination of pollen grains, pollen tubes growth, fertilization and fruit initiation must take place successfully (Kinet and Peet, 1997). Induction of artificial parthenocarpy through application of PGRs enables fertilization-independent fruit development that can reduce yield fluctuation in crops like tomato, pepper and likes (Heuvelink and Korner, 2001). This could be possible by foliar application of certain PGRs like auxin and GA_3 that bring the possibility of tomato production under adverse environmental conditions. Gemici *et al.* (2006) reported that application of synthetic auxin and gibberellins (GA_3) are effective in increasing both yield and quality of tomato. Those PGRs are used extensively in tomato to enhance yield by improving fruit set, size and number (Batlang, 2008; Serrani *et al.*, 2007) and could have practical application for tomato growers.

Research Procedure

The experiment was conducted at Main Vegetable

Research Station, Anand Agricultural University, Anand during *Kharif-Rabi* 2010-11, which is located on 22º-35' north latitude and 72º-55' east longitude and has an elevation of 45m above the mean sea level. The area is characterized by low and erratic rainfall with mean annual rainfall of 864 to 870 mm with peaks in July to August. The site is classified as typical sandy loam locally known as "Goradu". It is alluvial in origin, deep, well drained and has fairly good moisture holding capacity. Soil was poor in organic matter content. The mean annual temperature is 32.4ºC to 40.9ºC and hottest month observed in the month of May.

The seedlings were transplanted on 12th September 2010. Irrigation, weeding and plant protection measures were done whenever necessary. The experimental plot was ploughed, well prepared and a uniform dose of NPK (75:37.5:37.5 kg/ha) was applied as par agronomic practices. The seedlings were planted with 90 x 45cm. The experiment was laid out in RBD with three replications with nine treatments (T) *viz.*, T_1-GA_3 @ 20mg/l, T_2-GA_3 @40mg/l, T_3- KNO_3 @ 2000mg/l, T_4- KNO_3 @ 4000mg/l, T_5- $KHCO_3$ @2000mg/l, T_6- $KHCO_3$ @ 4000mg/l, T_7-boric acid @ 100mg/l, T_8- boric acid @ 200mg/l and T_9-control (without spray) were applied at 45 days after transplanting (DATP) as a foliar application.

The data were recorded on plant height (cm), number of leaves per plant, number of branches per plant, days to flowering, days to maturity stage, number of fruits per plant and total yield (q/ha). The statistical analysis of the data generated during the course of investigation was carried out through software following the procedure described by Cochran and Cox (1967). The variances of different sources of variation in ANOVA were tested by "F-test" and compared with the value of Table 1 at 5% level of significance. S.Em. +, critical differences and co-efficient of variation (C.V. %) were also worked out.

Research Analysis and Reasoning

The results of the present study as well as relevant discussions have been presented under following sub heads:

Plant height:

The data on plant height at 45 and 75 DATP as influenced by different treatments are presented in Table 1. The perusal of the data revealed that the effect of different treatments on plant growth of tomato recorded at 45 DATP was non-significant. Though, the maximum plant height was recorded in T_2 followed by T_1, T_8 and T_7, the value being 100.23, 99.80, 96.73 and 96.13cm, respectively. While, it was the minimum *i.e.* 91.33cm in T_9 (Control), followed by T_4 (95.07cm), T_6 (95.20cm) and T_3 and T_5 (95.37cm).

However, the plant height observed at 75 DATP was found significantly higher in treatment T_2 (114.77cm) which was recorded at par with T_1 (114.57cm). Whereas, the minimum plant height was recorded at 75 DATP under the treatment T_9 (94.27cm) and found to be at par with T_5 (97.47cm), T_4 (98.30cm), T_3 (99.40cm), T_6 (99.60cm), T_7 (100.23cm) and T_8 (100.80cm), respectively. This might be due to the GA_3 enhanced cell division with considerable stem elongation and increased the plant height. These findings are accordance with the results reported by Uddain *et al.* (2009), Masroor *et al.* (2006) and Naeem *et al.* (2001) in tomato plant.

Table 1: Influence of pre harvest treatments on growth and yield attributing characters of tomato cv. 'Anand Tomato-3'

Sr. No.	Treatments (T)	Plant height (cm)		Number of branches /plant		Number of leaves / plant		Days to flower initiation		Maturity stage		No. of fruit per plant	Fruit yield (q/ ha)
		45 DATP	75 DATP	45 DATP	75 DATP	45 DATP	75 DATP	First flower initiation	50% flowering	Breaker stage	Red-ripe stage		
1.	T_1	99.80	114.57	9.47	11.17	64.27	78.00	45.63	55.50	78.07	86.90	28.73	378.09
2.	T_2	100.23	114.77	9.53	12.13	64.73	80.10	45.23	55.53	78.03	86.47	30.70	384.77
3.	T_3	95.37	99.40	7.93	9.30	60.50	68.13	47.43	58.67	84.07	90.90	25.60	335.39
4.	T_4	95.07	98.30	7.77	9.33	59.07	69.10	49.43	58.50	87.23	91.50	25.60	328.19
5.	T_5	95.37	97.47	7.93	9.07	60.90	70.67	47.37	58.07	86.30	91.60	25.70	341.05
6.	T_6	95.20	99.60	7.63	9.20	58.07	68.47	48.17	58.73	89.37	93.97	24.73	313.79
7.	T_7	96.13	100.23	7.97	9.43	61.10	70.13	46.87	57.63	83.50	90.73	26.03	346.19
8.	T_8	96.73	100.80	8.13	10.03	61.00	70.43	46.87	57.37	84.10	90.43	26.00	351.34
9.	T_9	91.33	94.27	6.97	7.63	54.10	61.37	48.73	63.00	92.43	104.77	22.27	295.78
10.	Mean	96.14	102.16	8.15	9.70	60.41	70.71	47.30	58.11	84.79	91.92	26.15	341.62
	S.E.$\pm$	3.70	4.37	0.53	0.53	2.43	2.75	2.08	2.19	2.53	2.89	1.33	16.60
	C.D. (P=0.05)	NS	13.11	NS	1.58	NS	8.26	NS	NS	7.59	8.66	3.99	49.77
	C.V.%	6.67	7.41	11.33	9.42	6.97	6.75	7.61	6.54	5.17	5.44	8.82	8.42

NS=Non-significant DATP- Days after transplanting

Number of leaves per plant:

The result on number of leaves at 45 and 75 DATP as influenced by different treatments are presented in Table 1. The effect of various treatments on number of leaves at 45 DATP was found non-significant. Though, numerically higher number of leaves per plant at 45 DATP was recorded in T_2 (64.73), followed by T_1 (64.27), T_7 (61.10) and T_8 (61.00). While, the minimum number of leaves per plant was observed in T_9 (54.10) followed by T_6 (58.07), T_4 (59.07), T_3 (60.50) and T_5 (60.90).

Whereas, number of leaves recorded at 75 DATP was found significant. The treatment T_2 (80.10) recorded significantly the maximum number of leaves per plant which was at par with in T_1 (78.00). While, it was the lowest in T_9 (61.37), which was at par with the treatment T_3 (68.13), T_6 (68.47) and T_4 (69.10). This is due to the increase in cell division with considerable stem elongation by the application of GA_3. Uddain *et al.* (2009) and Masroor *et al.* (2006) found same trend of result in tomato.

Number of branches per plant:

The data pertaining to the number of branches per plant as influenced by various treatments are presented in Table 1. It can be seen from the result that the effect of GA_3 and chemicals on the number of branches was found to be non-significant at 45 DATP. Though, the treatment noted the maximum value in T_2 *i.e.* 9.53 followed by T_1 (9.47), T_8 (8.13) and T_7 (7.97). Whereas, the lowest branches per plant was observed under the treatment T_9 followed by T_6, T_4, T_3 and T_5, the value being 6.97, 7.63, 7.77, 7.93, respectively.

With regard to number of branches per plant at 75 DATP, the differences among the treatments were found significant as compared to control. The treatment T_2 (12.13) recorded significantly the highest and was found at par with the treatment T_1 (11.17). While, the minimum value was recorded with the untreated control T_9 (7.63) and it was at par with T_5 (9.07), T_6 (9.20), T_3 (9.30), T_4 (9.33), T_7 (9.43) and T_8 (10.03). Similar trend of result was also reported by other scientist like Uddain *et al.* (2009) and Masroor *et al.* (2006).

Days to flower initiation:

The data on days to first flower initiation and 50 per cent flowering in tomato cv. 'Anand tomato-3' as influenced by different treatments are represented in Table 1. Results on days to flower initiation and 50 per cent flowering influenced by various treatments showed non-significant effect. Though, the number of days required for first flower initiation was found to be higher in treatment T_4 *i.e.* 49.43 followed by T_9 (48.73) and T_6 (48.17days). While, T_2 (45.23days) and T_1 (45.63 days) noted the minimum days for first flower initiation followed by T_7 and T_8 (46.87days).

A similar trend was also observed in case of days to 50 per cent flowering. The maximum days for 50 per cent flowering was observed in treatment T_9 (63.00days) followed by T_6 (58.73) and T_3 (58.67days). However, the minimum number of days for 50 per cent flowering was recorded under the treatment T_1 (55.50days) followed by T_2 (55.53), T_8 (57.37) and T_7 (57.63days). This might be due to that GA_3 induced flower initiation in tomato plant through promoting cell division and cell enlargement (Buchanan *et al*., 2000). These findings are in accordance with the results reported by Uddain *et al.* (2009) and Naeem *et al.* (2001) in tomato plant.

Maturity stage:

The number of days taken for breaker and red-ripe stage of tomato fruits after the treatments of GA_3 and others chemicals was found to be significant as compared to control. The result collected on days to different maturity stages are presented in Table 1.

The minimum days taken for breaker stage of fruit was recorded in T_2 *i.e.* 78.03 and which was at par with T_1 (78.07), T_7 (83.50), T_3 (84.07) and T_8 (84.10days). The maximum days was recorded in treatment T_9 (92.43days), which was at par with T_6 (89.37), T_4 (87.23) and T_5 (86.30days). Similarly, the minimum days required for red-ripe stage was in T_2 *i.e.* 86.47days, which was at par with T_1, T_8, T_7, T_3, T_4, T_5 and T_6, the value being, 86.90, 90.43, 90.73, 90.90, 91.50, 91.60 and 93.97days, respectively, whereas, it was the maximum in treatment T_9 *i.e.* 104.77 days. The result of the present study divulged with the result of (Khan *et al*., 2006; Sasaki *et al*., 2005).

Number of fruits per plant:

The result for number of fruits per plant influenced due to treatments of GA_3 and others chemicals are presented in Table 1. Differences in number of fruits per plant were found significant among the treatments. The perusal of the data revealed that the number of fruits per plant was the maximum in T_2 (30.70), which remained at par with T_1 (28.73). While, the minimum fruit per plant was recorded in T_9 (22.27), it was par with T_6 (24.73), T_3 (25.60), T_4 (25.60), T_5 (25.70), T_8 (26.00) and T_7 (26.03). The increase in number of fruits per plant was due to the influence of GA_3 that promoted flower primordial production in tomato. The result is in agreement with the findings of Gelmesa *et al.* (2010), Uddain *et al.* (2009), Masroor *et al.*(2006), Naeem *et al.* (2001) in tomato, Patil *et al.* (2008) in brinjal. They indicated that the significant role of GA_3 in tomato plant to increase fruit set that leads to larger number of fruit size and final yield.

Total yield per plot (q/ha):

The result of fruit yield showed significant differences among the various treatments, presented in Table 1. The treatments T_2 recorded significantly the highest *i.e.* 384.77q/ha which remained at par with the treatment T_1 (378.09q/ha), T_8 (351.34q/ha), T_7 (346.19q/ha) and T_5 (341.05q/ha).

However, the minimum fruit yield was recorded under the treatment T_9 *i.e.* 295.78q/ha. It was found at par with the treatment T_6, T_4 and T_3 *i.e.* 313.79, 328.19 and 335.39q/ha, respectively. The significant effect of GA_3 in tomato plant was explained *via* its role in synthesis of DNA, RNA, protein (Broughton and Mc Comb, 1971; Johri and Varner, 1968; Roth and Lips,1970) including various enzymes and ribose and polyribosome multiplication (Evins and Verner, 1972) would contribute towards biomass production of vegetative parts as well as fruits and their contents. These would increase rate of shoot elongation and photosynthesis capacity leading to leaf area development and leaf dry weight. These findings are supported by Gelmesa *et al.* (2010), Uddain *et al.* (2009), Masroor *et al.* (2006), Naeem *et al.* (2001) in tomato and Patil *et al.* (2008) in brinjal.

Conclusion:

The results indicated that the pre harvest treatment of gibberellic acid, KNO_3, $KHCO_3$ and boric acid played a very effective role in vegetative growth and yield attributing characters of tomato plant. It can be concluded that an application of gibberellic acid, GA_3 @ 40mg/l as foliar application to the tomato plants cv. 'Anand Tomato-3' was found the most beneficial and efficient treatment for better vegetative growth in terms of days to flowering, plant height, number of leaves and branches per plant at 75 DATP and days to maturity stages. Similar trends was also observed under the T_2 (GA_3 @ 40mg/l) for the yield attributing characters like number of fruits per plant and total yield (q/ha) as compared to the others treatments.

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