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Influence of NAA, GA_3 on Quality and Yield of Tomato (*Lycopericon esculentum* L.)

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ABSTRACT

Tomato (Lycopericon esculentum L.) is one of the most important commercial vegetable crops grown all over the world and occupies the 3rd position among vegetables in area and production in the world. It belongs to the family Solanaceae and said native of Tropical America. The yield attributing characters viz., fruit length and diameter, weight per fruit and fruit yield per plant varied significantly due to varieties. Variety 'Sel.-7' produced maximum fruit diameter (4.80 m), fruit length (3.99 cm), weight per fruit (65.51 g), number of fruits (24.97/plant) and fruit yield per plant (1.24 kg). It variety 'Sel.-7' being at par with 'Pusa Ruby' resulted in significantly highest fruit yield (317.04 q/ha) which was 16.76 and 17.56 per cent higher than that produced by 'DVRI-1' and 'J.T.-99', respectively. The quality characters like number of locules and T.S.S. did not deviate significantly among varieties, but varieties had significant impact on their shelf life of fruit. Shelf life of fruit varied from 5.96 to 7.40 days and maximum and minimum values was recorded by 'J.T.-99' and 'Pusa Ruby'. The Increasing level of plant growth regulators reflected in decreased percentage of fruit set, weight/fruit and fruit yield/plant. Therefore, the lowest level of plant growth regulators (15 ppm GA_3 and 25 ppm NAA) was registered with the maximum fruit set (71.10%), weight per fruit (65.83 g) and fruit yield per plant (1.54 kg). The highest fruit yield of 393.04 q/ha was recorded with '15 ppm GA_3 followed by 25 ppm NAA' and it was 39.19 and 101.22 % higher over the fruit yield obtained with '30 ppm GA_3 followed by 50 ppm NAA' and '45 ppm GA_3 followed by 75 ppm NAA', respectively. It Variety 'Sel.-7' sprayed with 15 ppm GA_3 followed by 25 ppm NAA gave highest gross and net return along with B:C ratio (Rs. 132821/ha, Rs. 99581/ha and 4.00) followed by 'Pusa Ruby' sprayed with same concentration of plant growth regulators (Rs. 122363/ha, Rs. 89123/ha and 3.68).

Key words: *Tomato, Varieties, GA_3, NAA, Quality and Yield*

INTRODUCTION

Tomato (*Lycopericon esculentum* L.) is universally treated as ''Protective food". Tomato fruit is being rich in vitamins and minerals. The fresh and ripe tomato fruits are widely used throughout the year as salad. Tomato number one processing vegetables is used to produce sauce, ketchup, juice, powder, paste, chutney, puree and in a lot of other ways.

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It is reported to have anticancer properties of mouth, stimulates torpid liver and also useful in chronic dyspepsia. India is the second largest producer of vegetables (101.43 million tonnes) after China (423.30 million tonnes) and shares about 11.5% of the total production in the world while China shares about 48% of the total production. In India, Tamilnadu leads in vegetable productivity (28.9) followed by Kerala (23.1) MT/ha. In India, Tomato ranks third in production with share of 8.52%, production 8637.7 thousand MT and the area fourth rank share of 7.37%, area 497.6 (000 ha), and productivity 17.4 MT/ha under vegetable[10], while in Madhya Pradesh, it is cultivated about an area of 23000 ha with a production of 0.52 million tones.

Plant growth regulators are the organic compounds other than nutrient, which in small amounts, promote or modify the physiological processes of plant. The yield and quality can be improved of a great extend by genetic manipulations. However, the spray with Plant growth regulators has also been observed to improve the yield quality of tomato. In regards to influence of Plant growth regulators, Naphthalene acetic acid (NAA) plays an important role in high quality of vegetable and fruit production. NAA is being used to boost up the remarkable vegetative propagation. NAA helps to promote plant growth by enhancing the cell division, cell elongation and cell differentiation which may initiate the development of plant organs. It is also essentially required for the formation of root cambium and epicycle which may induce the formation lateral roots. It's also interesting to note that NAA also enhanced the flowering, heavy fruit setting and check abortion of young embryo and fruit drop. If a plant is sufficiently developed premature flowering may be induced by direct application of GA to young plants. This action is not sustained and treatment may have to be repeated. Formation of male flower is generally promoted by concentration of 100 to 200 ppm, female flower by concentration of 200 to 300 ppm concentration more than 600 ppm markedly suppress initiation of both male and female flower. Spraying fruit tree at full-blossom or when the blossoms being to wither can offset the detrimental effect of frost. When there is difficulty with fruit set because of incomplete pollination, GA may be effectively used to increased fruit set. The resulting fruit may be partially or entirely seedless. It that application of NAA at higher concentration (100 ppm) reduced the number of fruit set per cluster, fruit length, fruit width, number of locules per fruit, weight per fruit and fruit yield over lower concentration i.e. 50 ppm[14]. Keeping these facts in view the present investigation is being proposed.

MATERIAL AND METHOD

The experimental was laid out near Hi-tech Horticulture Area, Department of Horticulture, College of Agriculture, Indore (M.P.), during *Rabi* season of 2008-09 to evaluate the response of tomato varieties to different plant growth regulators under Malwa condition. Indore is situated in the Malwa plateau in western part of M.P. at 22º 43' N latitude and of 75º 66' E longitude with an altitude of 555.5 m above sea level. Indore belongs to sub-tropical and semi arid climate having a temperature range of minimum 7ºC and maximum 44ºC in winter and summer, respectively. In this area most of the rainfall is received during mid-June to early October with occasional showers in winter. Southwest monsoon is responsible for major part of annual precipitation. The average rainfall is 941 mm. The soil of the experimental field was medium black clay (vertisols) with uniform topography and pH 7.5 with 0.47 The soil was low in available nitrogen and phosphorus and high in available potassium. A uniform dose 120 kg N/ha through urea, 60 kg P_2O_5/ha through SSP and 80 kg K_2O/ha through MOP were applied in all the experimental plots.organic carbon content, analyzing available N (220 kg/ha), low P (9.70 kg/ha) and K (290 kg/ha) contents having 0.50 mmhos/cm electrical conductivity in 2008-09. The experiment was laid out in Randomized block design with 3 replications having 4 tomato variety (J.T.-99, Pusa ruby,

Sel. 7, DVRI-1) and 3 combinations of plant growth regulators at different concentrations [H_1- 15 ppm GA_3 followed by 25 ppm NAA, H_2- 30 ppm GA_3 followed by 50 ppm NAA, H_3- 45 ppm GA_3 followed by 75 ppm NAA]. The total treatment combination was 36. The data of various parameters were recorded at different stages of quality and yield parameters the data recorded at 20 days intervals analyzed statistically by method of analysis of variance.

RESULT AND DISCUSSION

Quality attributes

The quality parameters (table no.1) like Percentage of fruit set (%), Number of locules, Shelf life of fruit and Total soluble solid (%) were significantly influenced by Percentage of fruit set was significantly higher in 'Sel.-7'' (72.53%) followed by Pusa Ruby' (70.36%) and 'J.T.-99' (69.49%). Crop sprayed with 45 ppm GA_3 followed by 75 ppm NAA resulted in significantly lowest percentage of fruit set (64.98%) as compared to the fruit set obtained from the crop when sprayed with 30 ppm GA_3 followed by 50 ppm NAA and 15 ppm GA_3 followed by 25 ppm NAA. Rai *et al.*[8], reported that higher temperature interferes with fruit set and results in flower drop. The foliar application of growth regulating substances and micronutrients reduces the flower drop, increases the fruit set and improves the yield of tomatoes. They found that application of GA_3 and IAA increased fruit set percentage and total fruit yield as well as percentage of puffy and parthanocarpic fruits and compared to control[4]. The similarly results were also found in the work of Sasaki *et al.*[11], Serrani *et al.*[12] in tomato and Dhar and Majumdar[2] in chilli.

The quality characters like number of locules and T.S.S. did not deviate significantly among varieties, but varieties had significant impact on their shelf life of fruit. Maximum shelf life of the fruits (8.55 days) was recorded with the treatment combination V_3H_2 followed by V_1H_3 (8.10 days), V_1H_1 (7.66 days) and V_4H_1 (7.55 days) without significant margins. T.S.S. varied from 3.50% (Pusa Ruby) to 4.39% (Sel.-7) and from 3.71% (30 ppm GA_3 followed by 50 ppm NAA) to 4.38% (15 ppm GA_3 followed by 25 ppm NAA). The Number of locules and T.S.S. unaffected due to Plant growth substance levels, but shelf life of the fruits differed significantly due to Plant growth substance levels. Masroor *et al.*[5], conducted a pot experiment to study the effect of 4 levels of gibberellic acid spray (0, 10-8, 10-6, and 10-4 M GA_3) on the growth, leaf NPK content, yield & quality parameters of two tomato cultivar, namely HYB-SC-3 and Hyb-Himalata. Irrespective of its concentration spray of GA_3 proved beneficial for most parameter, especially in the case of Hyb-SC-3. Reported that application of GA_3 above 20 ppm concentration reduced the plant height, branches per plant, internodal length, fruits per plant, secondary root and TSS[9].

Yield attributes

Yield attributing (table no.2) characters viz., fruit length and diameter, weight per fruit and fruit yield per plant varied significantly due to varieties. Variety 'Sel.-7' produced maximum fruit diameter (4.80 m), fruit length (3.99 cm), weight per fruit (65.51 g) and fruit yield per plant (1.24 kg). Variety 'Sel.-7' being at par with 'Pusa Ruby' resulted in significantly highest fruit yield (317.04 q/ha) which was 16.76 and 17.56 per cent higher than that produced by 'DVRI-1' and 'J.T.-99', respectively[6]. recorded maximum days to flowering (42.67), fruit per plant (77.69), plant height (77.78 cm), fruit weight (71.15 gm), number of branches (12.33) per plant and total yield (26840 kg/ha) in the plants sprayed with 60 mg/lit of gibberellic acid 10 days before transplantation, while minimum values were noted in controlled treatment. Maximum fruit drop per plant was found for control treatment and minimum for the plants treated with gibberellic acid at 60 mg/lit. The observed reduction in plant height, branches per plant, fruits per plant, fruit weight per plant, fruit yield, fruit dry matter and weight per fruit due to application of 40 ppm NAA and 10 ppm GA_3 as compared to 20 ppm NAA and 5 ppm GA_3 in tomato[13].

Fruit yield of tomato was also significantly influenced with the foliar

application of plant growth regulators. Application of plant growth regulators at lower concentration (15 ppm GA_3 followed by 25 ppm NAA) recorded significantly higher fruit yield (393.04 q/ha) with the percentage increase of 39.19 and 87.21 over higher concentrations i.e. 30 ppm GA_3 followed by 50 ppm NAA and 45 ppm GA_3 followed by 75 ppm NAA, respectively[7]. observed that the combination treatment of GA_3 and Nutra-Phos 3–15 appeared antagonistic and resulted in significantly lower fruit yield and delayed maturity. However, GA_3 and Nutra-Phos 3–15 treatments alone produced higher fruit yields than the combination with no effect on fruit maturity compared to the control. Reported that the application of 75 ppm NAA along with multiplex resulted in largest fruit size at maturity stage of tomato and gave maximum yield[3]. The similarly results was also found in the work of Alam and Khan[1] in tomato and Singh[15] reported in onion.

Interaction of varieties × plant growth substance levels had significant effect on shelf life of fruits. Variety 'Sel.-7' sprayed with 15 ppm GA_3 followed by 25 ppm NAA resulted highest number of fruits per plant, while maximum shelf life of fruit was obtained from the treatment combination V_3H_2. The fruit yield was found to be non significant. However, maximum fruit yield (442.74 q/ha) was noted with treatment combination V_3H_1.

Table No. 1 Quality attributes characters

Plant growth substance levels (H)	Varieties (V)																			
	Percentage of fruit set (%)					Number of locules					Shelf life of fruit					Total soluble solid (%)				
	V_1	V_2	V_3	V_4	Mean	V_1	V_2	V_3	V_4	Mean	V_1	V_2	V_3	V_4	Mean	V_1	V_2	V_3	V_4	Mean
H_1	73.14	74.50	73.23	63.54	71.10	4.20	3.87	3.87	4.00	3.98	7.66	6.00	6.11	7.55	6.83	4.50	4.00	4.83	4.17	4.38
H_2	71.30	71.67	72.18	61.13	69.07	3.77	4.07	3.97	3.30	3.78	6.44	5.88	8.55	6.77	6.91	4.00	3.17	3.83	3.83	3.71
H_3	64.02	64.92	72.18	58.81	64.98	4.33	4.20	4.07	3.53	4.03	8.10	5.99	6.99	7.11	7.05	4.17	3.33	4.50	4.17	4.04
Mean	69.49	70.36	72.53	61.16		4.10	4.04	3.97	3.61		7.40	5.96	7.22	7.14		4.22	3.50	4.39	4.06	
Interaction																				
	V		**H**		**V×H**	**V**		**H**		**V×H**	**V**		**H**		**V×H**	**V**		**H**		**V×H**
SEm±	1.62		1.40		2.81	0.30		0.26		0.52	0.22		0.19		0.37	0.23		0.20		0.41
CD(p=0.05)	4.75		4.11		NS	NS		NS		NS	0.63		NS		1.09	NS		NS		NS

- **Note:** V_1 –J.T.-99, V_2 – Pusa Ruby, V_3 – Sel.-7, V_4 – DVRI-1
- H_1 – Application of 15 ppm GA_3 followed by 25 ppm NAA
- H_2 – Application of 30 ppm GA_3 followed by 50 ppm NAA
- H_3 – Application of 45 ppm GA_3 followed by 75 ppm NAA

Table No. 2 Yield attributes characters

Plant growth substance levels (H)	Varieties (V)																			
	Fruit weight (g)					Fruit diameter (cm)					Fruit length (cm)					Fruit yield (q/ha)				
	V_1	V_2	V_3	V_4	Mean	V_1	V_2	V_3	V_4	Mean	V_1	V_2	V_3	V_4	Mean	V_1	V_2	V_3	V_4	Mean
H_1	57.75	69.30	77.40	58.88	65.83	4.90	4.56	4.88	4.54	4.72	3.99	2.94	4.10	3.85	3.72	358.63	407.88	442.74	362.92	393.04
H_2	49.70	61.08	63.35	50.99	56.28	4.74	4.35	4.89	4.54	4.63	3.61	3.25	3.87	3.77	3.63	248.18	313.60	308.40	259.30	282.37
H_3	41.70	47.35	55.79	45.04	47.47	4.61	4.35	4.64	4.37	4.49	3.84	3.17	4.00	3.75	3.69	195.44	199.52	199.99	192.33	196.82
Mean	49.72	59.24	65.51	51.64		4.75	4.42	4.80	4.48		3.81	3.12	3.99	3.79		267.42	307.00	317.04	271.52	

Interaction												
	V	H	V×H	V	H	V×H	V	H	V×H	V	H	V×H
SEm±	1.69	1.46	2.92	0.09	0.08	0.16	0.10	0.09	0.17	9.55	8.27	16.53
CD(p=0.05)	4.95	4.29	NS	0.28	NS	NS	0.29	NS	NS	28.00	24.25	NS

- **Note:** V_1 –J.T.-99, V_2 – Pusa Ruby, V_3 – Sel.-7, V_4 – DVRI-1
- H_1 – Application of 15 ppm GA_3 followed by 25 ppm NAA
- H_2 – Application of 30 ppm GA_3 followed by 50 ppm NAA
- H_3 – Application of 45 ppm GA_3 followed by 75 ppm NAA

CONCLUSION

It was concluded that Variety 'Sel.-7' gave higher values of most of the quality and yield attributing characters and resulted in significantly highest fruit yield followed by 'Pusa Ruby'. The Foliar application of 15 ppm GA_3 followed by 25 ppm NAA produced superior growth and yield attributing characters and ultimately fruit yield of tomato. Higher concentrations of GA_3 and NAA beyond 15 and 25 ppm were not found advantageous for tomato crop. Combination of variety 'Sel.-7' and 15 ppm GA_3 25 ppm NAA was found best in respect increasing productivity of tomato crop. In respect of net income, the variety 'Sel.-7' sprayed with 15 ppm GA_3 followed by 25 ppm NAA recorded the highest net income (Rs. 99581/ha) followed by 'Pusa Ruby' sprayed with same concentration (Rs. 89123/ha) due to maximum gross monetary return. It Variety 'Sel.-7' sprayed with 15 ppm GA_3 followed by 25 ppm NAA gave highest gross and net return along with B:C ratio (Rs. 132821/ha, Rs. 99581/ha and 4.00) followed by 'Pusa Ruby' sprayed with same concentration of plant growth regulators (Rs. 122363/ha, Rs. 89123/ha and 3.68).

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