RESEARCH ARTICLE

INFLUENCE OF PLANT GROWTH REGULATORS ON GROWTH, YIELD AND ITS QUALITY OF TOMATO (*LYCOPERSICON ESCULENTUM* MILL.)

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Abstract: On the basis of experiment conducted during rabi season of 2018 – 2019 at Vegetable Research Farm Kalyanpur, Department of Vegetable Science of C. S. Azad University of Agriculture and Technology, Kanpur with the summary of results it can be concluded that plant height (cm)., number of primary and secondary branches per plant., number of fruits per plant., fruit length (cm)., fruit diameter (cm)., fruit weight (g)., fruit yield per plant (g) and yield per hectare (q) were increased with GA_3 @ 40 ppm concentration however number of flowers were increased with 2, 4-D @ 5 ppm while the TSS and weight of 100 seed were increased by 2, 4-D @ 10 ppm concentrations. Among NAA treatments NAA 25 ppm produced higher (69.95 cm) plant height followed by NAA 20 (67.16 cm) and15 ppm (66.39 cm) which were significantly greater over control (59.36 cm). The NAA at 25 ppm concentration produced 69.95 cm plant height which was significant over NAA 20 and 15 ppm while NAA 20 and 15 ppm did not differed significantly.

Kewword: Influence of plant growth, Yield, Quality

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) belongs to the genus *Lycopersicon* under Solanaceae family. Tomato is a herbaceous sprawling plant growing to 1-3 m in height with weak woody stem. It is a true diploid with 2n=24. Plant is annual with herbaceous prostrate stem having determinate or indeterminate growth habit. In the determinate growth, terminal bud ends in a floral bud and further growth is arrested resulting in dwarf and bushy stature. In indeterminate growth, terminal bud is a leafy bud and terminal and lateral buds continue to grow and there are less production of flowers and fruits on main stem. Flowers are borne in racemose cyme and flower cluster is known as "truss" and its position is extra axillary. The flowers are yellow in colour. They are hermaphrodite, pendulous, pentamerous and hypogynous. Stamens are six in number and inserted on throat of corolla tube and anthers are convent around style. Tomato is a self-pollinated crop due to hermaphrodite flowers, introvert stigma, internal and synchronized anther dehiscence, and stigma respectively. Tomato is a native to Peruvian and Mexican region. Though there are no definite records of when and how it came to India, the Portuguese perhaps introduced it to India. Tomato is one of the most important "protective foods" because of its special nutritive value. It is one of the most versatile vegetable with wide usage in Indian culinary tradition. The fruits of cultivated Tomato varieties vary in size from cherry tomatoes, about 1–2 cm in size to beefsteak tomatoes, about 10 cm or more in diameter. Most cultivars produce red fruits when ripe. Tomato is a native to Peruvian and Mexican region. Though there are no definite records of when and how it came to India, the Portuguese perhaps introduced it to India. Tomato is one of the most important "protective foods" because of its special nutritive value. It is one of the most versatile vegetable with wide usage in Indian culinary tradition. The fruits of cultivated Tomato varieties vary in size from cherry tomatoes, about 1–2 cm in size to beefsteak tomatoes, about 10 cm or more in diameter. Most cultivars produce red fruits when ripe. The yield of tomato can be increased and sustained by agronomic and nutritional management or by some exogenous supplementation with enzymes or growth hormones. Several important growth and development processes in plants are controlled and influenced by plant growth regulators (PGRs). Plant hormone is an organic substance which promotes growth of plant and used in low concentration. Plant hormones play a significant role in physiological phenomena.

MATERIALS AND METHODS

The field experiment entitled **"Influence of plant growth regulators on growth, yield and quality of Tomato (*Lycopersicon esculentum* Mill.)"** was conducted at Vegetable Research Farm Kalyanpur, Department of Vegetable Science of C. S. Azad University of Agriculture and Technology, Kanpur during *rabi* season of 2018 – 2019. The important growth regulators GA_3, NAA and 2, 4-D were taken as foliar spray under different concentrations individually i.e. GA_3 20, 30, 40 ppm, NAA at15, 20, 25 ppm and 2, 4-D 5, 10, 15 ppm along with a control (water spray). Such a way in this experiment there were 10 treatments taken as above and tested against control, replicated thrice in Randomised Block Design (RBD). $\mathbf{T_1}$ GA_3 20 ppm, $\mathbf{T_2}$ GA_3 30 ppm, $\mathbf{T_3}$ GA_3 40 ppm, T_4 NAA 15 ppm $\mathbf{T_5}$ NAA 20

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ppm **T_6** NAA 25 ppm. **T_7** 2, 4 D 5 ppm **T_8** 2, 4 D 10 ppm **T_9** 2, 4 D 15 ppm and **T_{10}** Control (water spray). The observations recorded was Plant Height (cm), Number of primary branches per plant, Number of secondary branches per plant, Number of flowers per plant, Number of fruits per plant, Length of fruit (cm), Diameter of fruit (cm), Fruit Weight (g), Fruit Yield per plant (g), Fruit Yield per Hectare (q), Total soluble solid (TSS), Weight of 100 seeds (mg)

Table 1. Influence of different concentrations of GA_3, NAA and 2, 4-D on plant height (cm)

Symbol	Treatments	Plant height (cm)
T_1	GA_3 20 ppm	71.07
T_2	GA_3 30 ppm	74.05
T_3	GA_3 40 ppm	76.06
T_4	NAA 15 ppm	66.39
T_5	NAA 20 ppm	67.16
T_6	NAA 25 ppm	69.95
T_7	2, 4-D 5 ppm	60.48
T_8	2, 4-D 10 ppm	58.33
T_9	2, 4-D 15 ppm	56.61
T_{10}	Control (water spray)	59.36
	SE(d)	**0.64**
	CD at 5 %	**1.35**

Table 2. Influence of different concentrations of GA_3, NAA and 2, 4-D on number of primary branches per plant

Symbol	Treatment	Number of primary branches per plant		
		30 DAT	**60 DAT**	**90 DAT**
T_1	GA_3 20 ppm	7.2	11.51	12.96
T_2	GA_3 30 ppm	7.42	11.57	13.20
T_3	GA_3 40 ppm	7.54	12.41	13.32
T_4	NAA 15 ppm	5.62	9.23	10.74
T_5	NAA 20 ppm	6.19	9.49	11.40
T_6	NAA 25 ppm	6.76	9.81	11.85
T_7	2, 4-D 5 ppm	5.89	9.14	10.18
T_8	2, 4-D 10 ppm	5.47	9.03	10.06
T_9	2, 4-D 15 ppm	5.01	8.95	9.08
T_{10}	Control (water spray)	4.83	8.06	8.99
	SE(d)	**0.10**	**0.21**	**0.25**
	CD at 5 %	**0.22**	**0.45**	**0.53**

Table 3. Influence of different concentrations of GA_3, NAA and 2, 4-D on number of secondary branches per plant

Symbol	Treatment	Number of secondary branches per plant		
		30 DAT	**60 DAT**	**90 DAT**
T_1	GA_3 20 ppm	1.68	8.23	12.42
T_2	GA_3 30 ppm	1.71	8.64	12.59
T_3	GA_3 40 ppm	1.78	8.74	12.80
T_4	NAA 15 ppm	1.34	6.74	9.89

T_5	NAA 20 ppm	1.39	7.13	10.13
T_6	NAA 25 ppm	1.46	7.58	11.49
T_7	2, 4-D 5 ppm	1.27	6.71	9.56
T_8	2, 4-D 10 ppm	1.25	6.55	9.35
T_9	2, 4-D 15 ppm	1.15	5.87	8.91
T_{10}	Control (water spray)	1.09	5.73	8.54
	SE(d)	**0.02**	**0.17**	**0.13**
	CD at 5 %	**0.05**	**0.37**	**0.28**

Table 4. Influence of different concentrations of GA_3, NAA and 2, 4-D on number of flowers per plant

Symbol	Treatments	Number of flowers per plant
T_1	GA_3 20 ppm	34.37
T_2	GA_3 30 ppm	35.08
T_3	GA_3 40 ppm	36.48
T_4	NAA 15 ppm	34.19
T_5	NAA 20 ppm	33.32
T_6	NAA 25 ppm	32.92
T_7	2, 4-D 5 ppm	36.74
T_8	2, 4-D 10 ppm	31.10
T_9	2, 4-D 15 ppm	30.57
T_{10}	Control (water spray)	29.82
	SE(d)	**0.83**
	CD at 5 %	**1.76**

Table 5. Influence of different concentrations of GA_3, NAA and 2, 4-D on number of fruits per plant

Symbol	Treatments	Number of fruits per plant
T_1	GA_3 20 ppm	30.44
T_2	GA_3 30 ppm	30.88
T_3	GA_3 40 ppm	32.67
T_4	NAA 15 ppm	26.16
T_5	NAA 20 ppm	28.00

T_6	NAA 25 ppm	28.24
T_7	2, 4-D 5 ppm	24.55
T_8	2, 4-D 10 ppm	23.41
T_9	2, 4-D 15 ppm	23.30
T_{10}	Control (water spray)	21.93
	SE(d)	**0.83**
	CD at 5 %	**1.76**

Table 6. Influence of different concentrations of GA_3, NAA and 2, 4-D on fruit length (cm)

Symbol	Treatments	Fruit length (cm)
T_1	GA_3 20 ppm	4.49
T_2	GA_3 30 ppm	4.75
T_3	GA_3 40 ppm	5.15
T_4	NAA 15 ppm	4.27
T_5	NAA 20 ppm	4.45
T_6	NAA 25 ppm	4.47
T_7	2, 4-D 5 ppm	3.99
T_8	2, 4-D 10 ppm	4.03
T_9	2, 4-D 15 ppm	4.11
T_{10}	Control (water spray)	3.66
	SE(d)	**0.11**
	CD at 5 %	**0.23**

Table 7. Influence of different concentrations of GA_3, NAA and 2, 4-D on fruit diameter (cm)

Symbol	Treatments	Fruit diameter (cm)
T_1	GA_3 20 ppm	6.18
T_2	GA_3 30 ppm	6.58
T_3	GA_3 40 ppm	6.75
T_4	NAA 15 ppm	5.07
T_5	NAA 20 ppm	5.44
T_6	NAA 25 ppm	5.86
T_7	2, 4-D 5 ppm	4.28
T_8	2, 4-D 10 ppm	4.50
T_9	2, 4-D 15 ppm	4.69
T_{10}	Control (water spray)	3.88
	SE(d)	**0.15**
	CD at 5 %	**0.33**

Table 8. Influence of different concentrations of GA_3, NAA and 2, 4-D on fruit weight (g)

Symbol	Treatments	Fruit weight (g.)
T_1	GA_3 20 ppm	56.76
T_2	GA_3 30 ppm	58.11
T_3	GA_3 40 ppm	61.38
T_4	NAA 15 ppm	50.30
T_5	NAA 20 ppm	51.28
T_6	NAA 25 ppm	57.76
T_7	2, 4-D 5 ppm	44.02

T_8	2, 4-D 10 ppm	46.06
T_9	2, 4-D 15 ppm	48.07
T_{10}	Control (water spray)	40.94
	SE(d)	**0.92**
	CD at 5 %	**1.94**

Table 9. Influence of different concentrations of GA_3, NAA and 2, 4-D on fruit yield per plant (g)

Symbol	Treatments	Fruit yield per plant (g)
T_1	GA_3 20 ppm	1264.81
T_2	GA_3 30 ppm	1287.99
T_3	GA_3 40 ppm	1321.91
T_4	NAA 15 ppm	1008.46
T_5	NAA 20 ppm	1110.18
T_6	NAA 25 ppm	1124.84
T_7	2, 4-D 5 ppm	996.57
T_8	2, 4-D 10 ppm	985.34
T_9	2, 4-D 15 ppm	910.48
T_{10}	Control (water spray)	889.72
	SE(d)	**4.17**
	CD at 5 %	**8.82**

Table 10. Influence of different concentrations of GA_3, NAA and 2, 4-D on fruit yield (q/h)

Symbol	Treatments	Fruit yield (q/h)
T_1	GA_3 20 ppm	478.89
T_2	GA_3 30 ppm	497.16
T_3	GA_3 40 ppm	520.45
T_4	NAA 15 ppm	429.82
T_5	NAA 20 ppm	445.26
T_6	NAA 25 ppm	457.18
T_7	2, 4-D 5 ppm	422.31
T_8	2, 4-D 10 ppm	413.19
T_9	2, 4-D 15 ppm	388.05
T_{10}	Control (water spray)	370.56
	SE(d)	**5.03**
	CD at 5 %	**10.65**

Table 11. Influence of different concentrations of GA_3, NAA and 2, 4-D on TSS (^{0}Brix)

Symbol	Treatments	TSS (^{0} Brix)
T_1	GA_3 20 ppm	5.24
T_2	GA_3 30 ppm	5.27
T_3	GA_3 40 ppm	5.20
T_4	NAA 15 ppm	5.38
T_5	NAA 20 ppm	5.40
T_6	NAA 25 ppm	5.37
T_7	2, 4-D 5 ppm	5.39
T_8	2, 4-D 10 ppm	5.62
T_9	2, 4-D 15 ppm	5.58
T_{10}	Control (water spray)	5.26
	SE(d)	**0.02**
	CD at 5 %	**0.05**

Table 12. Influence of different concentrations of GA_3, NAA and 2, 4-D on weight of 100 seeds

Symbol	Treatments	Weight of 100 seeds (mg)
T_1	GA_3 20 ppm	258
T_2	GA_3 30 ppm	265
T_3	GA_3 40 ppm	265
T_4	NAA 15 ppm	275
T_5	NAA 20 ppm	278
T_6	NAA 25 ppm	281
T_7	2, 4-D 5 ppm	290
T_8	2, 4-D 10 ppm	305
T_9	2, 4-D 15 ppm	295
T_{10}	Control (water spray)	245
	SE(d)	**7.61**
	CD at 5 %	**16.12**

RESULTS AND DISCUSSION

The maximum plant height of 76.06 cm was recorded at 40 ppm GA_3 as compared to control (59.36 cm) followed GA_3 30 ppm (74.05 cm). Significantly GA_3 at 40 ppm concentration produced maximum number of primary branches per plant at 30, 60 and 90 DAT i.e. 7.54, 12.41 followed by GA_3 30 ppm (7.52, 11.57 and 13.20) as compared to control 4.83, 8.06 and 8.99. Number of secondary branches per plant were similarly affected higher values under GA_3 at 40 ppm (1.78, 8.74and 12.80) followed by GA_3 30 ppm (1.71, 8.74 and 12.59) were recorded. Whereas minimum branches were obtained under control (1.09, 5.73 and 8.54). Significantly the maximum (36.74) number of flowers per plant was recorded from 2, 4-D at 5 ppm followed by GA_3 40 ppm (36.48) while the minimum (29.82) number of flowers per plant was recorded under control. Maximum number of fruits per plant were found (32.67) from GA_3 40 ppm and the minimum (30.36) was recorded under control. Significantly the maximum (5.15 cm) fruit length of tomato was recorded under GA_3 40 ppm against the minimum (3.66 cm) in control. The maximum (6.75 cm) fruit diameter was recorded by the treatment of GA_3 40 ppm and other treatments also produced significantly higher values of fruit diameter as compared to control (3.88 cm). The maximum average fruit weight was recorded significantly by GA_3 40 ppm (61.38 g) followed by GA_3 30 ppm (58.11 g) while the minimum (40.94 g) weight of fruit was recorded under control. GA_3 at 40 ppm concentration proved best treatment and maximum yield of 1321.91 g per plant was noticed as compared to control (889.7 g). Significantly the maximum (520.45 q/ha) was recorded at GA_3 40 ppm followed by GA_3 30 ppm (497.16 q/ha) while the minimum yield per hectare was recorded under control (370.56 q/ha). Treatment of 2, 4-D 10 ppm produced significantly maximum TSS (5.62^0Brix) followed by 2, 4-D 15 ppm (5.58^0Brix) while the minimum TSS was recorded by GA_3 40 ppm (5.20^0Brix). Significantly the maximum 100 seed weight (305 mg) was exhibited by the treatment of 2, 4-D 10 ppm while the minimum (245 mg) was recorded under control.

CONCLUSION

On the basis of experiment conducted during *rabi* season of 2018 – 2019 at Vegetable Research Farm Kalyanpur, Department of Vegetable Science of C. S. Azad University of Agriculture and Technology, Kanpur with the summary of results it can be concluded that plant height (cm)., number of primary and secondary branches per plant., number of fruits per plant., fruit length (cm)., fruit diameter (cm)., fruit weight (g)., fruit yield per plant (g) and yield per hectare (q) were increased with GA_3 @ 40 ppm concentration however number of flowers were increased with 2, 4-D @ 5 ppm while the TSS and weight of 100 seed were increased by 2, 4-D @ 10 ppm concentrations.

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