Original Research Article

Effect of plant growth regulators on growth, yield and quality of brinjal (*solanum melongena* l.) cv. Kashi Sandesh

ABSTRACT

A field experiment was conducted to find out the Effect of plant growth regulators on growth, yield and quality of brinjal (*Solanum melongena* L.) cv. Kashi Sandesh at the Horticultural Research Farm, Department of Horticulture, Udai Pratap (Autonomous) College, Varanasi during the year 2020-21. The experiment was laid out in Randomized Block Design with three replications and nine treatments. There were two plant growth regulators *viz.*GA_3 and NAA was used with different concentrations and applied by foliar application to assess the effect of growth, yield and quality of brinjal. Excellent results was found in Treatment T_8 -NAA + GA_3 (40 ppm + 50 ppm) for all the characters *viz.* maximum plant height (71.14 cm), Number of leaves per plant (71.65), Number of branches (12.77), Days to 50% flowering (43.12), Number of fruit per plant (16.17), Fruit length (11.66 cm), Fruit weight (180.48 g), Fruit diameter (9.48 cm), Fruit yield (2.91 kg/plant), Fruit yield (29.22 kg/plot), Fruit yield (383.95 q/ha), Net return (421750.86 Rs./ha) and B:C ratio (2.73) which was followed by treatment T_7- and T_6- and in other hand T_9- Control was gives poor performance among all the treatments. Hence considering the positive effect of NAA 40 ppm + GA_3 50 ppm was found to be beneficial for brinjal growing farmers under Varanasi (U.P.) condition.

Key Words- Brinjal, PGRs, Growth, Yield and Economics.

INTRODUCTION

Brinjal (*Solanum melongena* L.) is one of the most common, popular and principal vegetable crops grown in India and other parts of the world. The brinjal is grown extensively in India and other Asian countries like Bangladesh, Pakistan, and Philippines. Major brinjal producing countries are China, Turkey, Japan, Egypt, Indonesia, Iraq, Italy, Syria and Spain. The cultivated brinjal of Indian origin has been in cultivation for long time (Thompson and Kelly, 1957). In India, it is one of the most common and popular vegetable crop grown throughout the country, except the higher altitude. The production of brinjal is governed not only by the inherent genetic yield potential of the cultivars but it is greatly influenced by several environmental factors and cultivation practices.

Brinjal fruits are fairly good source of Ca, P, Fe, and vitamins particularly 'B' group (Kiran *et al.* 2010). Brinjal is also valued for its medicinal properties and role of brinjal in treatment of liver disease, cough due to allergy, rheumatism, leucorrhea and intestinal worms has been mentioned (Das and Barua; 2013). Like other vegetables, it provides dietary fiber, minerals, vitamins, carbohydrate and protein. Plant growth regulators are known to influence on higher yields as well as quality in horticultural crops. Recently, there has been global realization of the important role of PGR‟s in increasing crop yield. GA_3 is an important growth regulator that may have many uses to modify the growth, yield and yield contributing characters of plant (Rafeekher *et al.* 2002). Plant growth regulators are used widely to improve plant performance. GA_3 is one of those growth regulators that have positive effect on plant growth through the effect on cell division and elongation (Batlang *et al.,* 2006). It recorded dipping of brinjal seedling roots in NAA at 0.1 or 0.2 ppm for 24 hours influenced growth and development (Vaja *et al.* 2017). The advantage of plant growth regulators like Gibberellic (GA_3), Indol Acetic Acid (IAA), Nephthaline Acetic Acid (NAA), 2-4- Diclorophenoxy Acetic Acid (2,4-D) can be taken to increase the yield of local variety of brinjal.

MATERIAL AND METHODS

The present experiment was carried out in research farm of Department of Horticulture at udai pratap (autonomous) college, Varanasi under agro- climatic conditions of Eastern region of Uttar Pradesh during the *rabi* season 2020-21 on brinjal variety Kashi Sandesh (Round). Seedling were uprooted from the nursery beds and transplanted in the main plots at a spacing of 70 cm row to row and 60 cm plant to plant. Transplanting was done in the evening hours immediately followed by irrigation for proper establishment of the seedlings. All the recommended package of practices was followed to raise a healthy crop.The experiment consisted of two levels of gibberellic acid (GA_3), two levels of naphthalene acetic acid (NAA) and their combinations was arranged in randomized block design with three replications and nine treatments *viz.* (T_1) - NAA (20 ppm), (T_2) - NAA (40 ppm), (T_3)- GA_3 (25 ppm), (T_4) - GA_3 (50 ppm), (T_5) – NAA + GA_3 (20 ppm + 25 ppm), (T_6) – NAA + GA_3 (20 ppm + 50 ppm), (T_7) - NAA + GA_3 (40 ppm + 25 ppm), (T_8) - NAA + GA_3 (40 ppm + 50 ppm) and (T_9) - Control.

The required weight of the PGRs was taken using electronic sensitive balance and solution was prepared by dissolving in 1 mg L-1. The solution was poured into hand-held sprayer and was directly sprayed on the plants three times at 30, 45 and 60 days after transplanting. Spraying was performed early in the morning to avoid rapid drying of the spray solution, due to transpiration. Data were collected from randomly selected five plants in each row. The collected data includes Plant height (cm), No. of leaf/plant, No. of branches per plant, Days to 50% flowering, No. of fruit per plant, Fruit length (cm), Weight of fruits (g), Fruit diameter (cm), Fruit Yield (Kg/plant), Yield (kg/plot) and Yield (q/ha). The data was analyzed using analysis of variance (ANOVA) by software and mean separation was carried out at 5% probability level.

RESULTS AND DISCUSSIONS

The data was present in various attributes showed that table 1 at 30 DAT maximum plant height was found in T_8- NAA + GA_3 (40 ppm + 50 ppm) (41.92) followed by T_7 - NAA + GA_3 (40 ppm + 25 ppm) (36.18) and minimum was found in T_9 - Control (27.18), at 45 DAT maximum plant height in T_8- NAA + GA_3 (40 ppm + 50 ppm) (61.20) followed by (T_7) - NAA + GA_3 (40 ppm + 25 ppm) (57.84) and minimum was found in T_9-Control (37.75). At 60 DAT maximum plant height was found in T_8- NAA + GA_3 (40 ppm + 50 ppm) (71.14) followed by T_7- NAA + GA_3 (40 ppm + 25 ppm) (69.40) and minimum was found in T_9- Control (45.47). Gibberellin can promotes the activity of xyloglucan endotransglycosylase (XET) which cause loosening of cell wall and increase cell permeability (Saptari and Dawi 2013). Similar result was found in brinjal by Meena and Dhaka (2003).The no. of leaves per plant increased continuously from 30 to 60 DAT in all the treatments of Kashi Sandesh. At 30 DAT, the maximum no. of leaves (44.35 leaves) was recorded in treatment (T_8) - NAA + GA_3 (40 ppm + 50 ppm) and it was found significantly superior over other treatments followed by (43.12 and 42.31 leaves) in (T_7) - NAA + GA_3 (40 ppm + 25 ppm) and (T_6) – NAA + GA_3 (20 ppm + 50 ppm), whereas, minimum no. of leaves (32.26 leaves) was recorded in treatment (T_9) - Control. At 45 DAT, the maximum no. of leaves (47.12 leaves) was recorded in treatment (T_8) - NAA + GA_3 (40 ppm + 50 ppm) and it was found significantly superior over other treatments followed by (43.52 and 43.16 leaves) in (T_7) - NAA + GA_3 (40 ppm + 25 ppm) and (T_6) – NAA + GA_3 (20 ppm + 50 ppm), whereas, minimum no. of leaves (35.15 leaves) was recorded in treatment T_9- Control. At 60 DAT, the maximum no. of leaves (71.65 leaves) was recorded in treatment (T_8) - NAA + GA_3 (40 ppm + 50 ppm) and it was found significantly superior over other treatments followed by (68.59 and 67.38 leaves) in (T_7) - NAA + GA_3 (40 ppm + 25 ppm) and (T_6) – NAA + GA_3 (20 ppm + 50 ppm), whereas, minimum no. of leaves (41.63 leaves) was recorded in T_9-Control. The similar result was also found by (Hemlata & Raza; 2016), Kropi & Phonglosa; (2020) and Khaleghi *et al*.,(2021).

Number of branches increased continuously from 30 DAT to 60 DAT in all the treatments. At 30 DAT, no. of branches was found significantly higher in treatment T_8 - NAA + GA_3 (40 ppm + 50 ppm (9.49 plant-1) followed by T_7- GA_3 @ 50 ppm (8.40) and T_6- NAA @ 40 ppm (7.39), whereas, lowest no. of branches (3.80) was recorded in T_1- NAA (20 ppm). At 45 DAT, significantly higher no. of branches (10.07) was recorded in (T_8) - NAA + GA_3 (40 ppm + 50 ppm) followed by (T_7) - NAA + GA_3 (40 ppm + 25 ppm) (8.41) and (T_6) – NAA + GA_3 (20 ppm + 50 ppm) (7.60), whereas, lowest no. of branches (4.19) was recorded in T_9- Control. At 60 DAT, significantly higher no. of branches (12.77 plant-1) was recorded in (T_8) - NAA + GA_3 (40 ppm + 50 ppm) followed by (T_7) - NAA + GA_3 (40 ppm + 25 ppm) (11.80) and (T_6) – NAA + GA_3 (20 ppm + 50 ppm) (10.53), whereas, lowest no. of branches (4.48) was recorded in T9-Control. All the treatments were significantly influenced days taken to 50 per cent flowering. The minimum days to 50 per cent flowering (29.66) was obtained in the treatment (T_8) - NAA + GA_3 (40 ppm + 50 ppm) and it was found significantly superior over other treatments followed by (30.54) in (T_7) - NAA + GA_3 (40 ppm + 25 ppm), whereas, maximum days to 50 per cent flowering (43.12) were noted in T9- Control. Among the treatments, (T_8) - NAA + GA_3 (40 ppm

+ 50 ppm) recorded significantly higher number of fruits plant -1 (16.17 fruits) and it was observed significantly superior over other treatments. It is followed (T_7) - NAA + GA_3 (40 ppm + 25 ppm) (15.20 fruits). While, significantly lower number of fruits plant-1 was recorded with T_1-NAA (20 ppm) (8.67).The maximum fruit length (11.66 cm) was recorded in the treatment (T_8) - NAA + GA_3 (40 ppm + 50 ppm) and it was observed significantly superior over other treatment followed by (11.29 and 10.25 cm) in (T_7) - NAA + GA_3 (40 ppm + 25 ppm) and (T_6) – NAA + GA_3 (20 ppm + 50 ppm), whereas, minimum fruit length (5.45 cm) was recorded in T_9-Control.The maximum fresh weight (180.48 g) was recorded in the treatment (T_8) - NAA + GA_3 (40 ppm + 50 ppm) and it was observed significantly superior over other treatments followed by (177.99 and 176.50 g) in (T_7) - NAA + GA_3 (40 ppm + 25 ppm) and (T_6) – NAA + GA_3 (20 ppm + 50 ppm), whereas minimum fresh weight (163.59 g) was recorded in T_9- Control. The maximum fruit diameter (9.48 cm) was recorded in the treatment (T_8) - NAA + GA_3 (40 ppm + 50 ppm) and it was observed significantly superior over other treatments followed by (8.49 and 7.43 cm) in (T_7) - NAA + GA_3 (40 ppm + 25 ppm) and (T_6) – NAA + GA_3 (20 ppm + 50 ppm), whereas minimum fruit diameter (3.77 cm) was recorded in T_9- Control. The result was conformed with the previous findings by Khaleghi *et al.*(2021), Bagale *et al.* (2022) and Ruidas *et al.*(2022).

Among all the treatments, (T_8) - NAA + GA_3 (40 ppm + 50 ppm) recorded higher fruit yield plant-1 (2.91 kg) over other treatments. It is closely followed by 2.71 and 2.39 kg in (T_7) - NAA + GA_3 (40 ppm + 25 ppm) and (T_6) – NAA + GA_3 (20 ppm + 50 ppm) fruit yield plant-1. While, T_1 NAA (20 ppm) had the minimum (1.44 kg) fruit yield per plant. Yield kg per plot among the treatments, (T_8) - NAA + GA_3 (40 ppm + 50 ppm) recorded significantly higher yield (29.22 kg) and it was observed significantly superior over other treatments. It is followed (T_7) - NAA + GA_3 (40 ppm + 25 ppm) (28.13 kg). While, significantly lowest yield was recorded with T_9-Control (8.67 kg). Yield of brinjal in term of quintal per hectare was recorded maximum in treatment T_8-NAA + GA_3 (40 ppm + 50 ppm) i.e. (383.95) it is followed by (T_7) - NAA + GA_3 (40 ppm + 25 ppm) and (T_6) – NAA + GA_3 (20 ppm + 50 ppm) that was (379.84 and 376.85) respectively. In other hand least yield quintal per hectare (206.69) was observed in T_9- Control for this character. It was revealed that the maximum net return of Rs. 422710.86 q/ha with Benefit:Cost ratio of 2.75 was recorded in T_8 (@ 40 ppm NAA + @ 50 ppm GA_3). That was followed by T_7 (@ 40 ppm NAA + 25 ppm GA_3) with net income of Rs. 416581.86 q/ha along with Benifit:Cost ratio of 2.71 and minimum net return of Rs.185598.25 q/ha with Benefit:Cost ratio of 1.49 was observed in control. The result was supported with the findings of Athaneria *et al.* (2011), Patel *et al.* (2012), Veishnav *et al.* (2012), Kiranmayi *et al.* (2014) and Vandna *et al.* (2014).

As for fruit sample observed and given below in table 3 we can say that there are no any differences was found in fruit colour, Fruit shape and fruit size with the application of various doses of growth hormone, its combination and control. All the treatment including control was showed Purple colour, Round in shape and Medium size fruits. The similar result was recorded by Khaleghi *et al.*(2021) and Ruidas *et al.*(2022).

CONCLUSION

On the basis of present investigation it can be concluded that the treatment T_{8-} (NAA - 40 ppm + GA_3 -25 ppm) was produces maximum effect on most of all the growth characters and yield. Similarly, NAA - 40 ppm + GA_3 -25 ppm was supported not only in growth and yield parameters while also observed economically feasible in term of higher return (benefit cast ratio) as compare to other treatments.

Table 1 Effect of PGR on plant height, Number of leaf per plant and number of branches per plant at different successive stages in brinjal

Treatment	Plant height (cm)			No. of leaf/plant			No. of branches/plant		
	30 DAT	45 DAT	60 DAT	30 DAT	45 DAT	60 DAT	30 DAT	45 DAT	60 DAT
T_1	27.96	44.72	61.45	37.41	37.67	54.00	3.38	4.41	5.82
T_2	31.06	47.66	62.18	38.55	38.84	55.32	4.33	5.11	6.45
T_3	32.55	51.03	64.42	39.36	40.37	62.53	5.35	5.74	7.34
T_4	34.52	51.92	65.37	40.51	42.24	64.91	5.84	6.33	8.62
T_5	34.90	53.22	66.44	41.46	43.16	66.04	6.51	6.74	9.74
T_6	36.16	54.00	67.61	42.31	43.52	67.38	7.39	7.60	10.53
T_7	36.18	57.84	69.40	43.12	45.29	68.59	8.40	8.41	11.80
T_8	41.92	61.20	71.14	44.35	47.12	71.65	9.49	10.07	12.77
T_9	27.18	37.75	45.47	32.26	35.15	41.63	3.73	4.19	4.86
SE ±	**0.55**	**0.54**	**0.28**	**0.27**	**0.20**	**0.46**	**0.20**	**0.15**	**0.20**
CD (5%)	**1.67**	**1.63**	**0.84**	**0.81**	**0.60**	**1.38**	**0.60**	**0.47**	**0.61**

Table .2 Effect of PGR on Days to 50% flowering, No. of fruit/plant, Fruit length(cm), Weight of fruits (g), Fruit diameter (cm), Fruit Yield (Kg/plant), Yield (kg/plot), Yield (q/ha), Net return and B:C ratio at different successive stages in brinjal

Treatment	Days to 50% flowering	No. of fruit per plant	Fruit length (cm)	Weight of fruits (g)	Fruit diameter (cm)	Fruit Yield (Kg/plant)	Yield (kg/plot)	Yield (q/ha)	Net return (Rs./ha)	B:C Ratio
T_1	40.57	8.67	5.56	166.51	3.94	1.44	21.90	356.61	381785.34	2.49
T_2	37.75	9.82	6.28	168.23	3.94	1.65	23.32	362.48	390577.82	2.55
T_3	36.08	11.13	7.40	170.65	4.72	1.89	24.14	366.97	397301.82	2.59
T_4	34.43	12.00	7.94	171.79	5.49	2.06	25.42	370.44	402470.82	2.62
T_5	32.79	12.93	8.88	174.34	6.50	2.25	25.84	373.57	406829.34	2.64
T_6	31.44	13.56	10.25	176.50	7.43	2.39	27.33	376.85	412073.34	2.68
T_7	30.54	15.20	11.29	177.99	8.49	2.71	28.13	379.84	416581.82	2.71
T_8	29.66	16.17	11.66	180.48	9.48	2.91	29.22	383.95	422710.86	2.75
T_9	43.12	11.63	5.45	163.59	3.77	1.90	19.91	206.69	185598.25	1.49
SE ±	**0.42**	**0.18**	**0.28**	**1.18**	**0.12**	**0.02**	**0.18**	**0.85**	-	-
CD (5%)	**1.28**	**0.56**	**0.84**	**3.54**	**0.35**	**0.07**	**0.55**	**2.56**	-	-

Table 3 Fruit colour, fruit shape and fruit size is influenced by differenttreatments

Symbol	Treatment	Fruit colour	Fruitshape	Fruit size
T_1	NAA (20 ppm)	Purple	Round	Medium
T_2	NAA (40 ppm)	Purple	Round	Medium
T_3	GA_3 (25 ppm)	Purple	Round	Medium
T_4	GA_3 (50 ppm)	Purple	Round	Medium
T_5	NAA + GA_3 (20 ppm + 25 ppm)	Purple	Round	Large
T_6	NAA + GA_3 (20 ppm + 50 ppm)	Purple	Round	Large
T_7	NAA + GA_3 (40 ppm + 25 ppm)	Purple	Round	Large
T_8	NAA + GA_3 (40 ppm + 50 ppm)	Purple	Round	Large
T_9	Control	Purple	Round	Small

*** NAA-** Nephthaline Acetic Acid , **GA_3-** Gibberellic Acid and **ppm-** Part Per Million

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