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Efficacy of plant growth regulators on growth characters and yield attributes in brinjal (*Solanum melongena* L.) cv. Brinjal 3112

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Abstract: *The experiment was carried out during kharif season 2013, Department of Biological Sciences, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad, Uttar Pradesh.The efficacy of different Plant growth regulators and their and their combination of naphthalene acetic acid (NAA), gibberellic acid (GA_3) and dichlorophenoxyacetic acid (2,4-D) spray on fruit yield and quality in brinjal and the crop selected for the experiment was one brinjal variety Brinjal 3112 with three replicants. Plants were sprayed three times at 30, 60 and 90 days after transplanting. The highest plant height, number of leaves, plant fresh weight and plant dry weight was observed and ascorbic acid estimated for GA_3 @ 50 ppm. The highest number of branches, number of fruits, fresh fruit weight was observed and total soluble solid, nitrate reductase activity was recorded by the treatment combination of GA_3 @ 10 ppm, NAA @ 20 ppm. The combined application of GA_3, NAA and 2,4-D significantly increased vegetative growth, yield and quality of brinjal compared with control. Based on the results, it can be concluded that combined application of GA_3, NAA and 2,4-D @ 10 ppm, 20 ppm and 1 ppm of 2,4-D had significantly on plant growth, flowering, quality and yield potential.*

Key Words: *Gibberellic acid, 2,4-dichlorophenoxy acetic acid, Naphthalene acetic acid, Brinjal (Solanum melongena* L.*), growth, quality.*

I. Introduction

Brinjal (*Solanum melongena* L., 2n = 2x = 24) is a widely adaptive and highly productive vegetable crop of tropical and subtropical regions world, which suffers from various abiotic and biotic stresses (Kaur *et al*., 2004). It is one of the most popular vegetable crops in many parts of the world including India. The crop is cultivated on small family farms and considered to be important source of nutrition and cash income for many resource poor farmers (Bose *et al*., 1993). The brinjal is of much importance in the warm areas of Far East, being grown extensively in India, Bangladesh, Pakistan, China and the Philippines. In India, it is one of the most common, popular and principal vegetable crops grown throughout the country except higher altitudes. It is a versatile crop adapted to different agro-climatic regions and can be grown throughout the year. It is a perennial but grown commercially as an annual crop. A number of cultivars are grown in India, consumer preference being dependent upon fruit color, size and shape (Gopalan *et al*., 2007). The fruits are known for being low in calories and having a mineral composition beneficial for human health. They are also rich source of Potassium, Magnesium, Calcium and Iron (Zenia *et al*., 2008). Plant growth regulators like promoters, inhibitors or retardants play a key role in controlling internal mechanisms of plant by interacting with key metabolic processes such as, nucleic acid metabolism and protein synthesis. Use of the growth regulators (PGRs) might be a useful alternative to increase crop production. Recently, there has been global realization of the important role of PGR's in increasing crop yield. Gibberellic acid 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. Gibberellic acid 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 (Sambasiva Rao *et al*. 1980). Brinjal is known to have ayurvedic medicinal properties and is good for diabetic patients. It has also been recommended as an excellent remedy for those suffering from liver complaints (Shukla and Naik 1993). This study was therefore initiated to investigate the best dose of the PGRs under consideration in single or combined application that improve brinjal fruit yield and quality.

II. Material And Methods

The experiment was carried out during kharif season 2013 on Department of Biological Sciences, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad, (U.P.). The experiment consisted of three levels of gibberellic acid , two levels of naphthalene acetic acid and two levels of 2,4-dichlorophenoxyacetic acid and their combinations arranged in randomized block design with three replications

and nine treatments (T_0- Control, T_1- 10 ppm GA_3, T_2- 30 ppm GA_3, T_3- 50 ppm GA_3, T_4- 20 ppm NAA, T_5- 50 ppm, T_6- 1 ppm 2,4-D, T_7- 2 ppm 2,4-D and T_8- combinations of GA_3, NAA, 2,4-D @ 10 ppm, 20 ppm and 1 ppm of 2,4-D). 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, 60 and 90 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 selected plants in the rows. The collected data includes average plant height (cm), number of leaves/plant, number of branches/plant, number of fruits/plant, fresh fruit weight (g/plant), protein (mg/g) and ascorbic acid (mg/100g),. The data was analyzed using analysis of variance (ANOVA) by software and mean separation was carried out at 5% probability level.

III. Result And Discussion

3.1 Obsevation on growth parameters

3.1.1. Plant Height (cm)

At 30 DAT maximum plant height was found in T_3 (40.13) followed by T_8 (37.63) and minimum was found in T_0 (20.10), at 60 DAT maximum plant height in T_3 (54.30) followed by T_8 (52.07) and minimum was found in T_0 (34.24). At 90 DAT maximum plant height was found in T_3 (76.10) followed by T_8 (74.27) and minimum was found in T_0 (46.73). 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).

3.1.2. Number of leaves

At 30 DAT maximum number of leaves was found in T_3 (24.73) followed by T_8 (22.46) and minimum was found in T_0 (16.31), at 60 DAT maximum number of leaves was found in T_3 (53.26) followed by T_8 (52.18) and minimum was found in T_0 (41.53). At 90 DAT maximum number of leaves was found in T_3 (94.27) followed by T_8 (93.46) and minimum was found in T_0 (70.14). Similar result was found in tomato by Gabal *et al.* (1999).

3.1.3. Number of branches

At 30 DAT maximum number of branches was found in T_8 (8.90) and minimum was found in (4.60), at 60 DAT maximum number of branches was found in T_8 (22.90) and minimum was found in T_0 (11.38). At 90 DAT maximum number of branches T_8 (25.80) and minimum was found in T_0 (17.36). Similar result was found in chilli by Gollagi (1999) and tomato by Mehta *et al*. (1989).

3.2 Observation on physiological parameters

3.2.1 Ascorbic acid

Ascorbic acid maximum was found in T_3 (2.56 mg) and minimum was found in T_0 (1.51 mg). The augment of ascorbic acid with GA_3 treatment might be either due to encouragement of biosynthesis of ascorbic acid or protection of synthesized ascorbic acid from oxidation through the enzyme ascorbic acid oxidase and gibberellin may promote the activity of acid invertase which causing an increase in hexose level in plant tissue as was reported in chilli by Saptari and Dewi (2013) and Chattopadhyay and Sen (1974) and Desai *et al*. (1993) in chilli.

3.2.2 Nitrate reductase activity

At 30 DAT maximum nitrate reductase activity was found in T_8 (41.30) and minimum was found in T_0 (27.80), at 60 DAT maximum nitrate reductase activity was found in T_8 (124.20) and minimum was found in T_0 (74.60). At 90 DAT maximum nitrate reductase activity was found in T_3 (107.50) and minimum was found in T_0 (61.80). These growth regulators may have affected activity and thereby increasing supply of reduced nitrogen to support growth. Nitrate reductase, a key enzyme in control of nitrogen assimilation is target of several regulatory processes. Relationships between auxins and nitrate reductase have been reported by Vuylsteker *et al.* (1998).

3.3 Yield parameters

3.3.1. Number of fruits

Maximum number of fruits/plant was found in T_8 (18.83) and minimum was found in T_0 (9.31). Exogenous supply of growth regulators at critical stages of flowering and fertilization, ovary formation, fruit and seed development period etc. may enhance source to sink relationship, accumulation of photosynthates and efficient utilization of food reserves for the development of fruit. These results are supported by the findings of Mehta *et al*. (1989) in chilli.

3.3.2 Fruit weight per plant

Maximum fresh fruit weight/plant (kg) was found in T_8 (3.67 kg) and minimum was found in T0 (1.26 kg). The tomato plants exhibited improvements relevant to growth, sustainable health and enhancement in flowering & fruit parameters in such a coordinated manners for collective contribution toward the higher weight of fruit. These results are in confirmation with reported findings Sumiati, (1987) and Edison (1991) in tomato and Pampapathy and Rao (1975) in brinjal.

Table 1. Efficacy of plant growth regulators on growth parameters at different stages in Brinjal.

Treatments	Plant Height (cm)			Number of leaves/plant			Number of branches/plant		
	30DAT	60DAT	90DAT	30DAT	60DAT	90DAT	30DAT	60DAT	90DAT
T_0	20.10	34.24	46.73	16.31	41.53	70.14	4.60	11.38	17.36
T_1	25.80	40.30	60.71	18.24	47.10	85.48	6.90	20.42	21.27
T_2	28.90	44.42	62.24	19.78	50.13	87.10	7.30	21.50	22.53
T_3	40.13	54.30	76.10	24.73	53.26	94.27	8.34	22.70	24.32
T_4	28.18	42.10	62.31	18.86	47.90	86.08	6.74	20.23	23.60
T_5	36.24	48.62	69.20	21.31	50.77	90.16	7.60	21.80	24.12
T_6	29.02	43.14	66.18	17.23	46.36	85.30	5.10	17.30	20.50
T_7	37.45	51.02	68.32	19.12	48.68	86.92	6.40	21.24	23.52
T_8	37.63	52.07	74.27	22.46	52.18	93.46	8.90	22.90	25.80
F-test	S	S	S	S	S	S	S	S	S
S.Ed(±)	0.076	0.083	0.058	0.086	0.075	0.078	0.077	0.294	0.348
CD(5%)	0.156	0.171	0.119	0.178	0.156	0.160	0.159	0.608	0.719

Table 2. Efficacy of plant growth regulators on physiological and yield parameters at different stage in Brinjal.

Treatments	Number of fruits/plant	Fruits weight (kg/plant)	Ascorbic acid(mg/100g)	Nitrate reductase activity (µ mol NO_2/g fw/hr)		
				30DAT	60DAT	90DAT
T_0	9.31	1.26	1.51	27.80	74.60	61.80
T_1	12.60	1.55	1.89	35.70	90.40	84.40
T_2	13.20	1.78	2.17	37.40	94.20	84.50
T_3	16.32	2.06	2.56	40.30	106.40	95.30
T_4	14.30	1.83	1.77	38.60	95.80	86.70
T_5	18.32	2.87	1.83	39.80	98.40	93.50
T_6	16.90	2.23	1.86	36.20	93.60	84.10
T_7	17.30	3.05	1.92	37.80	95.30	85.40
T_8	18.83	3.67	2.34	41.30	124.20	107.50
F-test	S	S	S	S	S	S
S.Ed(±)	0.076	2.40	0.078	0.502	0.792	0.136
CD(5%)	0.157	4.97	0.160	1.036	61.636	0.281

IV. CONCLUSION

Results showed that foliar spray of plant growth regulators not only increased the vegetative growth and fruits but also enhanced the yield and quality of brinjal cv. "Brinjal- 3112". On the basis of one trial experiment, it is concluded that combined application of GA_3 (Gibberellic acid -10 ppm) with NAA (Naphthalene acetic acid-20 ppm) and 2,4-D (2,4-Dichloro phynoxy actic acid- 1 ppm) showed positively significant effect on growth, yield and physiological parameters (Ascorbic acid and Nitrate reductase activity) of brinjal.

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