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Effect of Plant Growth Regulators on Growth, Yield and Quality of Okra [*Abelmoschus esculentus* (L.) Moench]

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Abstract—*Growth regulators have enabled man to control the plant growth and have become the greatest tool in the hands of agriculturists for increasing yield and better quality crops. A field experiment was carried out to evaluate the effects of GA_3 and IBA on growth and yield attributes of okra (Abelmoschus esculentus L. Moench) cv. Arka Abhay. Four treatments each of GA_3 @ T_3-25, T_4-50, T_5-100 and T_6-150 (ppm) and IBA @ T_7-25, T_8-50, T_9-100 and T_{10}-150 (ppm) were used besides controls i.e. T_1- without spray and T_2-with water spray. Both growth regulators were found to enhance early flowering. Other parameters of growth and yield were also found to be increased by treatments with growth regulators in okra. The results revealed that highest yield was recorded from T_6 (324.87 g/plant) followed by T_7 (314.17 g/plant). All the growth and yield parameters of okra were more positively influenced by GA_3 as compared to IBA under respective treatment.*

Keywords*: Okra, growth regulators, plant growth, yield*

1. INTRODUCTION

Okra [*Abelmoschus esculentus* (L.) Moench] popularly known as lady's finger, is believed to be a native of Ethiopia (1). It is herbaceous annual plant belongs to family Malvacae growing in warm season as well as rainy season of both tropical and subtropical regions of the world. Okra is extensively grown in India throughout the year for its tender non-fibrous edible fruit. It is very popular among the farmers because of easy in growing and has wider adaptability range. It has good nutritional value. Besides being a vegetable, it also has medicinal and industrial important. India is the largest producer of okra.

The discovery of plant growth substances has been considered as a revolution in the history of agriculture as it has brought a range of new possibilities of delicate and wonderful adjustment of development pattern in plants. Plant growth regulators (PGR's) are organic compounds, which in small amounts modify physiological processes of plants. The role of plant growth regulators including both growth promoters and retardants, in crop production is a well known phenomenon (2).

The response with growth regulators depend upon the amount of particular compound absorbed by the seed or plant and ability of seed or plant to respond to the stimulus of the chemical applied. It is however, believed that the mechanism of action of a growth regulator in plant through same fundamental process involving the activities of the cell and the enzyme concerned in the process. Scientists have given due attention to the idea of regulating plant growth as an important factor in improving the growth, yield and quality parameters with the application of plant growth regulators in various ways. Its use in crop promotes growth along the longitudinal area, increase number of branches, early flower initiation, fruit set, fruit quality and subsequently contributes towards higher production when applied at various concentrations. The use of plant growth regulators has gained a separate field of study besides varietal, manurial and cultural methods of vegetable improvement.

Among the several growth substances, gibberellic acid (GA_3) and IBA are found very promising and these are being used in fruit and vegetable crops. The role of GA_3 in cell elongation in plant has been well established which resulted in increasing the plant height. GA_3 also enhances flowering in many species. Contrary to GA_3, IBA has been found to retard plant growth by reducing internodes length and also simultaneously it induces the formation of lateral shoots thereby plant possesses more number of fruits bearing shoots.

However, there is little information available on the effect of growth regulators on growth and yield of okra . In view of this, the present experiment was envisaged with a view to investigate the effect of GA_3 and IBA on growth, yield and quality of okra and to find out the suitable concentration.

2. MATERIALS AND METHODS:

An experiment was carried out to study the effect of plant growth regulators on growth, yield and quality of okra at Instructional Farm, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar during rainy season of 2015-2016. The experiment was laid out in R.B.D. with three replications having ten treatments including controls (T_1- without spray and T_2-with water spray). The treatments comprised of the combination of four concentrations of each plant growth regulators. The plant growth regulators used were GA_3 @ T_3-25, T_4-50, T_5-100 and T_6-150 (ppm) and IBA @ T_7-25, T_8-50, T_9-100 and T_{10}-150 (ppm). Seeds of okra cv. 'Arka Abhay' were sown at the spacing of 60 cm x 45 cm with a net plot size of 4.5 m^2. The crop was fertilized with 12 ton/ha FYM along with NPK@ 120:60:60 kg/ha. Each treatment comprised of seed soaking followed by foliar spray 30 DAS .

The observations were recorded on five randomly selected plants from each treatment. The data on parameters like node at which 1st flower appears, number of nodes/plant, number of flowers/plant, number of branches/ plant, number of fruit/plant, yield (g)/plant, number of seeds/fruit, 100 seed weight (g), length of fruit (cm) and girth of fruit (cm) were recorded. Analysis of variance was performed following the statistical method described by Panse and Sukhatme (3) and significance of differences among treatment means were calculated at 5% level of significance.

3. RESULTS AND DISCUSSION:

In the present investigation the effect of growth regulators i.e. GA_3 and IBA on several yield attributes presented in Table -1 and 2 revealed that foliar application of both the growth regulators significantly decreased the mean nodal position at which 1st flower appeared as compared to control treatments (Table-1). It is also found that number of nodes per plant, number of flower per plant, number of branches per plant at harvest, number of fruits per plant, length of fruits (cm) and girth of fruit (cm) have been significantly increased with the application of both plant growth regulators over control. The results also revealed that even water spray (T_2) had significant positive effects on yield attributing factors in comparison with control (without any spray) in this crop. It is found that growth regulators application has increased yield (g) / plant, number of seeds per fruits and 100 seed weight (g) in okra as compared to control (Table-2).

Comparisons between two growth regulators revealed that GA_3 treatments had more positive influence on growth and yield parameters than IBA. It was obvious from the results that T_6 (GA_3 @150 ppm) recorded best performance towards growth and yield attributes among all other treatments. It was also noticed that GA_3 treatments have more pronounced effects on the data recorded in comparison with respective IBA treatments. It might be due to that GA_3 could be involved in many aspects of plant growth and development, such as cell enlargement, internodes elongation, stimulated RNA and protein synthesis and thereby leading to enhanced growth and development (4).

The results of better performance of okra under growth regulator treatments might be due to the consequence of growth regulators on cell elongation, stimulated RNA and protein synthesis, and better diversion of food material towards flowering and fruiting. The positive influence of plant growth regulators on growth and yield of okra was in agreement of Kokare *et al*. (5) and Nawalkar *et al*., (6).

The results of increased seed yield by growth regulators were in accordance of Singh *et al.* (7), Sanganagoud *et al*. (8). Marie *et al*. (9) has reported an increase in number of seeds per fruit under growth regulator treatment. Increased length of fruits under growth regulator treatment was also reported by Kumar and Sen (10). Sanganagoud *et al.* (8) also reported an increase in fruit weight by GA_3 and cycocel.

4. CONCLUSION

From the avove results it may be concluded that plant growth regulators i.e. gibberellic acid and IBA have significant effect in increasing growth and development and yield of okra with increasing concentration of both. However, GA_3 is found to be a superior growth regulator as compared to respective doses of IBA.

Table 1: Effect of GA_3 and IBA on growth and yield attributes of okra

Treatment	Node at which 1st flower appears	Number of nodes / plant	Number of flowers /plant	Number of branches/plant at last	Number of fruit/ plant
T_1 control	6.87	20.75	18.60	2.70	15.50
T_2 control (water spray)	6.50	20.90	18.80	2.76	15.70
T_3 GA_3 – 25 ppm	5.75	24.95	21.25	2.96	16.55
T_4 GA_3 -50 ppm	5.60	25.00	21.40	3.05	16.95
T_5 GA_3 – 100 ppm	5.55	25.60	22.00	3.08	17.80
T_6 GA_3 - 150 ppm	5.20	25.85	22.60	3.10	18.20
T_7 IBA – 25 ppm	5.90	22.80	20.30	2.80	16.20
T_8 IBA – 50 ppm	5.86	22.90	20.70	2.84	16.40
T_9 IBA – 100 ppm	5.80	23.60	20.80	2.88	16.45
T_{10} IBA - 150 ppm	5.78	23.95	21.00	2.90	16.50
SEM(±)	**0.018**	**1.462**	**1.569**	**0.151**	**1.294**
C.D. (p < 0.05)	**0.401**	**3.592**	**3.721**	**1.153**	**3.380**

Table 2: Effect of GA_3 and IBA on growth and yield attributes of okra

Treatment	Yield /plant (g)	Number of seeds / fruit	100 seed weight (g)	Length of fruit (cm)	Girth of fruit (cm)
T_1 control	213.90	45.80	3.85	12.50	4.26
T_2 control (water spray)	222.94	46.10	3.95	12.56	4.30
T_3 GA_3 – 25 ppm	284.66	52.40	4.68	13.60	4.85
T_4 GA_3 -50 ppm	294.93	52.55	4.75	13.66	4.86
T_5 GA_3 – 100 ppm	314.17	52.85	4.95	13.74	4.88
T_6 GA_3 - 150 ppm	324.87	53.10	5.10	13.80	4.90
T_7 IBA – 25 ppm	264.87	48.75	4.25	13.10	4.60
T_8 IBA – 50 ppm	270.27	48.95	4.38	13.22	4.64
T_9 IBA – 100 ppm	275.37	49.35	4.52	13.36	4.72
T_{10} IBA -150 ppm	279.18	49.75	4.58	13.48	4.76
SEM (±)	**2.824**	**2.046**	**0.095**	**0.166**	**0.088**
CD (p < 0.05)	**4.993**	**4.250**	**0.915**	**1.212**	**0.879**

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