Crop Res. **52** (1, 2 & 3) : 37-40 (2017)
Printed in India

Effect of plant growth promoters on flowering and fruiting attributes of okra [*Abelmoschus esculentus* (L.) Moench]

VINITA KUMARI MEENA[1], A. K. DUBEY[1], VIKAS KUMAR JAIN*[,2], ANUPAM TIWARI[2] AND PRIYA NEGI[3]

[1]*Department of Horticulture*
Chandra Shekhar Azad University of Agriculture & Technology, Kanpur-208 002 (U. P.), India
**(e-mail : vikasjkumar88@gmail.com)*

(Received : March 11, 2017/Accepted : April 02, 2017)

ABSTRACT

A field experiment was carried out during rainy season of 2015 to study the effect of gibberellic acid (GA_3) and naphthalene acetic acid (NAA) on flowering and fruiting of okra. The experiment was planned using randomized block design with nine treatments and three replications comprising three levels of both GA_3 (50, 100 and 200 ppm) and NAA (50, 100 and 200 ppm) with two combination doses of NAA and GA_3 (50+50 ppm and 100+100 ppm). All variables regarding flowering and fruiting were significantly influenced by different concentrations of the growth regulators. Plant growth regulators (PGR) were less effective when applied individually as compared to their combined use; however, performance of plants treated with individual PGR was better than the untreated plants. Among all the combinations of NAA and GA_3 (50 ppm each) resulted in maximum internodal length (7.53 cm), number of nodes/plant (25.67), number of flowers/plant (25.33), fruit length (12.37 cm), fruit girth (1.91 cm) and number of fruits/plant (22.67), while took minimum days to flowering (35.67) and fruiting (38.33).

Key words : Flowering, GA_3, NAA, okra, plant growth regulators

INTRODUCTION

Okra [*Abelmoschus esculentus* (L.) Moench] is an important annual vegetable crop in tropical and sub-tropical parts of the world. It is mainly used for its tender green fruits as vegetable in many countries (Bayer and Kubitzki, 2003). Okra has a prominent position among vegetable fruits due to its high nutritive and medicinal value, ease of cultivation and wider adaptability to varying weathers (Reddy *et al.*, 2012).

India is the global leader in the okra production (Saxena *et al.*, 2016). Fertilizers, which are used to enhance productivity in okra are expansive and if not properly used hazardous for environment (Attigah *et al.*, 2013). Alternative sources or substitutes of fertilizer are, therefore, sought to increase yield of okra and wise different combinations of fertilizers have been used (Akande *et al.*, 2010). The requirement of fertilizers can be reduced by manipulating physiological process of the plant. Plant growth regulators are one of cheap and widely used physiological manipulators which can be used for productivity enhancement in okra. Although plant growth regulators have great potential for growth improvement but their application has to be planned sensibly in terms of optimal dose, stage of application, crop specificity and seasons (Khan *et al.*, 2006). Even the same growth regulator at different dose can bring about different results. These are considered as new generations of agrochemicals after fertilizers, insecticides and herbicides. Plant physiologists have recognized five well defined groups of plant growth substances viz., auxins, GA's, cytokinins, inhibitors (abscisic acid) and senescent hormone ethylene (Shahid *et al.*, 2013). Therefore, the use of plant growth regulators has led to intensive scientific activity for their commercial exploitation (Sultana *et al.*, 2006). Keeping these points in view, the present study was undertaken to ascertain the most suitable concentration of GA_3 and NAA

[2]Department of Horticulture, Institute of Agril. Sciences, B. H. U., Varanasi-221 005, India.
[3]Department of Fruit Science, VCSG, UUHF, Bharsar, Pauri Garhwal-246 123 (Uttarakhand), India.

for improving the flowering and fruiting of okra.

MATERIALS AND METHODS

The present experiment was carried out during rainy season of 2015 at the Vegetable Research Farm, Nawabganj, Kanpur Nagar, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur, Uttar Pradesh. The experiment was laid out in randomized block design with three replications. The treatments comprised three levels of GA_3 [T_1 (50 ppm), $T_{2\,(}$100 ppm) and T_3 (200 ppm)] and NAA [T_4 (50 ppm), T_5 (100 ppm) and T_6 (200 ppm)], two combinations of NAA and GA_3 [T_7 (NAA 50 ppm+GA_3 50 ppm) and T_8 [NAA (100 ppm+GA_3 100 ppm)] with untreated [T_0 (distilled water)]. Okra variety Arka Anamika was taken as test crop. A basal dose of 15 t/ha FYM was applied 15 days before sowing. Fertilizers (recommended dose) were supplied through single super phosphate (SSP), muriate of potash (MOP) and urea. Basal application of full dose of SSP, MOP and half dose of urea was given at the time of sowing and remaining half dose of urea was given as top dressing at 30 days after sowing. NAA and GA_3 were applied with hand sprayer sprayed at 2-leaf stage till run-off. Cultural and plant protection measures were implemented uniformly in all treatments as and when required. The observations were recorded on five randomly selected plants in each treatment. The data were analyzed statistically following the standard procedure given by Panse and Sukhatme (1954).

RESULTS AND DISCUSSION

Effect of GA_3 and NAA on Flowering in Okra

The application of plant hormones either alone or in combination significantly improved flowering and fruiting related traits. The results (Table 1) indicated that internodal length was greatly increased by the application of NAA 50 ppm+GA_3 50 ppm (7.53 cm) followed by the application of NAA 100 ppm+GA_3 100 ppm (7.27 cm), whereas minimum internodal length was found in controlled (5.18 cm). Same trends were also found in number of nodes/ plant as NAA 50 ppm+GA_3 50 ppm (25.67) shows highest followed by NAA 100 ppm+GA_3 100 ppm (24.33) and alone GA_3 100 ppm (24.33). Generally, it is considered better if flowering starts from lower nodes, here it is seen that NAA 50 ppm+GA_3 50 ppm (4.33) shows flowering at a significantly lower node which is at par with NAA 100 ppm+GA_3 100 ppm (4.44) and GA_3 200 ppm (4.66), whereas the upper most node for first flower seen in control (6.77). Same results were observed by Kokare *et al.* (2006), and Shahid *et al.* (2013).

Significantly less number of days was required for days to 1st flowering (35.67) with the treatment NAA 50 ppm+GA_3 50 ppm which was at par with NAA 100 ppm+GA_3 100 ppm (36.33) and GA_3 100 ppm (36.67), as compared to control and rest of the treatments. This might be due to the reason that GA_3 reduced the days required for flowering which ultimately led towards early flower production. These results were supported by Singh and Kumar (2005) and Bhagure and Tambe (2013). More number of flowers gives an idea about yield, here the combination of GA_3 and NAA i.e. NAA 50 ppm+GA_3 50 ppm showed maximum number of flowers per plant (25.33) followed by NAA 100 ppm+GA_3 100 ppm (24.33). This might be due to more number of nodes per plant in case of above said combinations. The result coincides with the findings of Patil and Patel (2010) and Mehraj *et al.* (2015).

Table 1. Effect of GA_3 and NAA on flowering in okra

Treatment	Internodal length (cm)	No. of nodes/plant	Node at which 1st flower appears	Days to 1st flower	No. of flowers/plant
T_0	5.18	22.33	6.77	41.67	17.67
T_1	5.30	22.67	6.21	40.67	19.67
T_2	7.03	24.33	4.77	36.67	21.67
T_3	6.60	23.33	4.66	39.67	23.67
T_4	5.80	23.00	5.10	38.67	20.33
T_5	5.60	23.67	4.88	36.67	23.00
T_6	7.03	22.67	5.22	38.67	18.67
T_7	7.53	25.67	4.33	35.67	25.33
T_8	7.27	24.33	4.44	36.33	24.33
C. D. (P=0.05)	0.26	0.50	0.36	2.082	0.66

Effect of GA_3 and NAA on Fruiting in Okra

Days to first fruit appearance is one of the important parameters attributing yield, treatment combination with NAA 50 ppm+GA_3 50 ppm showed earliest (38.33) fruit appearance followed by NAA 100 ppm + GA_3 100 ppm (39.67), whereas the control (43.67) was latest for appearance of flowering (Table 2). The fruit length (12.37 cm) observed with NAA 50 ppm+GA_3 50 ppm were at par with NAA 100 ppm+GA_3 100 ppm (11.60 cm) was significantly higher as compared to control and rest of the treatments. The increase in fruit length could be due to cell elongation. The results were supported by Kokare *et al.* (2006) and Ravat and Makani (2015) in okra. NAA and GA_3 lonely also increased the fruit length significantly as compared to control (9.27 cm).

The highest fruit girth (1.91cm) recorded with NAA 50 ppm+GA_3 50 ppm was significantly superior over control (1.41 cm) and rest of the treatments. This might be due to cell elongation capacity of GA_3 and NAA that induced more growth of okra fruits. These results are in accordance with the results of Katung *et al.* (2007). The average fruit weight was recorded highest under NAA 50 ppm+GA_3 50 ppm (15.33 g) followed by NAA 100 ppm+GA_3 100 ppm (13.67 g) and NAA 200 ppm (13.67 g) and NAA 50 ppm (13.67 g). This might be due to the growth by cell division, cell enlargement and cell expansion which ultimately improved the fruit weight. These results were supported by Singh and Kumar (2005) and Katung *et al.* (2007).

Table 2. Effect of GA_3 and NAA on fruiting in okra

Treatment	Days to 1st fruit appears	Fruit length (cm)	Fruit girth (cm)	Fresh weight of fruit (g)	No. of fruits/plant
T_0	43.67	9.27	1.41	10.67	13.33
T_1	43.33	10.57	1.58	11.33	16.00
T_2	40.00	11.50	1.68	13.00	16.67
T_3	43.00	11.37	1.65	11.67	19.33
T_4	41.67	10.50	1.49	13.67	15.33
T_5	40.33	10.57	1.54	12.33	18.67
T_6	39.67	10.30	1.50	13.67	15.33
T_7	38.33	12.37	1.91	15.33	22.67
T_8	39.67	11.60	1.79	13.67	20.33
C. D. (P=0.05)	0.98	0.53	0.05	1.31	1.96

CONCLUSION

The enhancement in the morphological parameters by GA_3 and NAA due to their effect on cell enlargement, cell growth, biochemical properties of protoplasm, respiration and nucleic acid metabolism, etc., the beneficial effect of GA_3 and NAA and its synergistic effect on plant growth parameters were also reported by many workers in case of okra and other vegetable crops. It could be concluded that flowering and fruiting of okra plant were significantly affected by the application of GA_3 and NAA at 50 and 100 ppm concentration each which ultimately increased the yield.

REFERENCES

Akande, M. O., Oluwatoyinbo, F., Makinde, E. A., Adepoju, A. S. and Adepoju, I. S. (2010). Response of okra to organic and inorganic fertilization. *Nature and Sci.* **8** : 261-66.

Attigah, A. S., Asiedu, E. K., Agyarko, K. and Dapaah, H. K. (2013). Growth and yield of okra (*Abelmoschus esculentus* L.) as affected by organic and inorganic fertilizers. *ARPN J. Agric. Biol. Sci.* **8** : 766-70.

Bayer, C. and Kubitzki, K. (2003). Malvaceae. p. 225-311. In : *The Families and Genera of Vascular Plants, Vol. V. Flowering Plants Dicotyledons,* K. Kubitzki (ed.). Springer, Berlin Heidelberg.

Bhagure, Y. L. and Tambe, T. B. (2013). Effect of seed soaking and foliar sprays of plant growth regulators on germination, growth and yield of okra [*Abelmoschus esculentus* (L.) Moench] var. Parbhani Kranti. *Asian J. Hort.* **8** : 399-402.

Katung, M. D., Olarewaju, J. D. and Mohammed, S. G. (2007). Seasonal response of okra [*Abelmoschus esculentus* (L.) Moench] varieties to gibberellic acid. *Adv. Hortic. Sci.* **21** : 14-18.

Khan, M. M. A., Gautam, C., Mohammad, F., Siddiqui, M. H., Naeem, M. and Khan, M. N. (2006). Effect of gibberellic acid spray on performance of tomato. *Turk. J. Bot.* **30** : 11-16.

Kokare, R. T., Bhalerao, R. K., Prabu, T., Chavan, S. K., Bansode, A. B. and Kachare, G. S. (2006). Effect of plant growth regulators on growth, yield and quality of okra [*Abelmoschus esculentus* (L.) Moench]. *Agric. Sci. Digest* **26** : 178-81.

Mehraj, H., Taufique, T., Ali, M. R., Sikder, R. K. and Jamaluddin, A. F. M. (2015). Impact of GA_3 and NAA on horticultural traits of *Abelmoschus esculentus*. *World Appl. Sci. J.* **33** : 1712-17.

Panse, V. G. and Sukhatme, P. V. (1954). *Statistical Methods for Agricultural Workers*. ICAR, New Delhi.

Patil, D. R. and Patel, M. N. (2010). Effect of seed treatment with GA_3 and NAA on growth and yield of okra [*Abmelmoschus esculentus* (L.) Moench] cv. GO-2. *Asian J. Hort.* **5** : 269-72.

Ravat, A. K. and Makani, N. (2015). Influence of plant growth regulators on growth, seed yield and seed quality in okra [*Abelmoschus esculentus* (L.) Moench] cv. GAO-5 under middle Gujarat conditions. *Intl. J. Agric. Sci.* **11** : 151-57.

Reddy, M. T., Haribabu, K., Ganesh, M., Reddy, K. C. and Begum, H. (2012). Genetic divergence analysis of indigenous and exotic collections of okra [*Abelmoschus esculentus* (L.) Moench]. *J. Agric. Tech.* **28** : 611-23.

Saxena, M., Bhatacharya, S. and Malhotra, S. K. (2016). *Horticultural Statistics at a Glance 2015*. Ministry of Agriculture & Farmers Welfare, Government of India, Oxford University Press, New Delhi.

Shahid, M. R., Amjad, M., Ziaf, K., Jahangir, M. M., Ahmad, S., Iqbal, Q. and Nawaz, A. (2013). Growth, yield and seed production of okra as influenced by different growth regulators. *Pak. J. Agric. Sci.* **50** : 387-92.

Singh, R. K. and Kumar, M. (2005). Response of summer season okra to plant growth regulators and foliar application of nitrogen. *Haryana J. Hort. Sci.* **34** : 187-88.

Sultana, W., Fattah, Q. A. and Islam, M. S. (2006). Yield and seed quality of chilli (*Capsicum annuum* L.) as affected by different growth regulators. *Bangladesh J. Bot.* **35** : 195-97.