

Synergistic Effect of NAA and GA₃ on Growth and Seed Attributes of Okra [*Abelmoschus esculentus* (L.) Moench]

Vinita Kumari Meena, A. K. Dubey,
Anupam Tiwari

Received 18 November 2016; Accepted 20 December 2016; Published online 7 January 2017

Abstract A field experiment was carried out during rainy season of 2015 to study the effect of GA₃ and NAA on growth and seed attributes of okra. The experiment was conducted in randomized block design with nine treatments comprising of each three levels of GA₃ (50, 100 and 200 ppm) and NAA (50, 100 and 200 ppm) with two combination doses of NAA and GA₃ (50 + 50 ppm and 100 + 100 ppm), replicated three times. All variables regarding growth and seed attributes were significantly influenced by different concentrations of the growth regulators. Growth regulators were less effective when applied individually as compared to their combined use; how-

ever, performance of plants treated with individual PGR was better than the untreated plants. Among all the treatments combination dose of NAA and GA₃ (50 ppm each) resulted maximum plant height (110.55 cm), number of branches per plant (5.67), stem diameter (26.71 mm), number of leaves per plant (30.33), total chlorophyll content (1.90 mg/g), fruit yield per plant (210.73 g), number of seeds per fruit (51) and germination (95.67%).

Keywords GA₃, NAA, Okra, Plant growth regulators.

Introduction

Okra [*Abelmoschus esculentus* (L.) Moench] is an economically important vegetable crop grown in tropical and sub-tropical parts of the India [1]. It is a multipurpose crop due to its various uses of the fresh leaves, buds, flowers, pods, stems and seeds. Okra immature fruits, which are consumed as vegetables, can be used in salads, soups and stews, fresh or dried, fried or boiled. Okra is a power house of valuable nutrients, nearly half of which is soluble fiber in the form of gums and pectins which help to lower serum cholesterol, reducing the risk of heart diseases [2]. The other fraction of okra is insoluble fiber, which helps to keep the intestinal tract healthy. Okra is also abundant with several carbohydrates, miner-

Vinita Kumari Meena*, Dr. A. K. Dubey
Department of Horticulture, CSAUA and T,
Kanpur 208002, India

Anupam Tiwari
Research Scholar, Department of Horticulture,
I.Ag.Sc., B.H.U., Varanasi 221005, India
e-mail : meenavinita1991@gmail.com

*Correspondence

als and vitamins, which play a vital role in human diet and health [3]. In recent years, researchers have given due attention to the idea of regulating plant growth as third most important factor in improving the growth, yield and quality with the application of plant growth regulators in various ways. The selection of right hormones, their appropriate concentration and their time and method of application are most essential. Even the same growth regulator at different concentrations can bring about different results. Keeping these points in view, the present study entitled effect of GA₃ and NAA on growth and seed attributes of okra [*Abelmoschus esculentus* (L.) Moench] cv Arka Anamika was undertaken to ascertain the most suitable concentration of GA₃ and NAA for improving the growth and yield 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 and Technology, Kanpur, Uttar Pradesh. The experiment was laid out in randomized block design with three replications. The treatments comprised of three levels each of GA₃ (T₁ 50 ppm, T₂ 100 ppm and T₃ 200 ppm) and NAA (T₄ 50 ppm, T₅ 100 ppm and T₆ 200 ppm), two combination of NAA and GA₃ (T₇ NAA + GA₃ 50 ppm + 50 ppm and T₈ 100ppm + 100 ppm) with untreated (T₀ distilled water). Okra cultivar Arka Anamika was taken as test crop. A basal dose of 15 tonnes per hectare FYM was applied 15 days before sowing. The recommended dose of nitrogen, phosphorous and Potassium for okra in this zone 100 kg, 60 kg and 50 kg/ha, respectively was applied. Fertilizers were calculated for each plot according to treatment area and applied uniformly in well prepared individual plots. Fertilizers were supplied through single super phosphate, mutriate of potash 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 GA₃ were applied with hand sprayer. It was sprayed at 2 leaf stage till runoff, either alone or in combination. The observations were recorded on five randomly selected plants in each treatment. The data were recorded on growth

parameters like plant height (cm), number of branches per plant, stem diameter (mm), number of leaves per plant, average length and width of leaves, leaf area per plant (cm²) and total chlorophyll content in leaves (mg/g of fresh weight), fruit yield per plant (g), number of seeds per fruit, 100 seed weight and germination percentage. The data were analyzed statistically following the standard procedure given by panse and sukhatme [4].

Results and Discussion

The application of both PGRs, either alone or in combination significantly improved growth related traits. Experimental findings clearly indicated that synergistic effect of GA₃ and NAA was better than single spray of any PGRs. Among all the treatments, combination dose of NAA and GA₃ (50 ppm + 50 ppm) resulted maximum plant height (115.78) followed by treatment T₈ after 60 days sowing (Table 1). The increase in plant height by GA₃ and NAA application has also been reported by Kokare et al. [5] and Singh et al. [6]. Significantly the highest number of branches per plant (5.67) was recorded with GA₃ and NAA @ 50 ppm + 50 ppm at last picking stage. This might be due to the reason that GA₃ promote the growth of auxiliary buds into new shoots which ultimately increase the number of branches per plant. These results are in agreement with those of Bhagure and Tambe [7]. Number of leaves and its characteristics in okra was found to be significantly affected

Table 1. Effect of NAA and GA₃ on growth and seed attributes of okra.

Treat- ments	Plant height (cm)			Number of branches/ plant	Stem dia- meter (mm)	Number of leaves/ plant
	30 DAS	45 DAS	60 DAS			
T ₀	58.7	93.7	103.49	3.67	24.22	22.00
T ₁	61.2	96.4	106.74	4.67	25.23	24.33
T ₂	63.1	97.2	107.94	3.67	25.54	25.00
T ₃	60.0	95.0	105.10	4.00	25.31	23.67
T ₄	62.4	97.6	107.82	5.33	26.11	26.00
T ₅	66.00	100	110.55	3.67	26.35	26.33
T ₆	63.1	97.7	107.83	3.33	24.84	22.33
T ₇	70.1	105.3	115.78	5.67	26.71	30.33
T ₈	68.2	101.01	111.02	5.33	26.05	28.00
CD at 5%	3.66	3.90	4.03	1.431	0.347	0.184

Table 2. Effect of NAA and GA₃ on growth and seed attributes of okra.

Treatments	Length of leaves (cm)	Width of leaves (cm)	Leaf area per plant (cm)	Total chlorophyll content (mg/g)	Fruit yield/plant (g)	Number of seeds per fruit	100 seed weight	Germination %
T ₀	18.63	13.33	24.85	1.39	133.00	43.67	4.41	88.67
T ₁	18.97	14.23	26.99	1.65	145.33	44.00	4.54	88.33
T ₂	20.43	16.10	32.91	1.72	165.67	45.00	5.37	91.00
T ₃	19.92	15.12	30.10	1.62	185.33	46.67	4.76	92.33
T ₄	19.97	15.25	30.50	1.50	140.33	45.67	4.77	92.33
T ₅	21.82	16.60	36.15	1.52	160.33	46.67	5.23	93.67
T ₆	21.22	16.13	34.21	1.45	180.67	47.33	5.02	94.67
T ₇	24.08	20.25	48.76	1.90	210.73	51.00	6.12	95.67
T ₈	22.91	18.16	41.66	1.67	195.00	48.33	5.71	93.33
CD at 5%	1.26	1.096	1.09	0.15	24.80	1.31	0.18	1.26

due to foliar application of NAA and GA₃. More number of leaves (30.33), average length (24.08) and width (20.25) of leaves, leaf area per plant (48.76 cm²) and total chlorophyll content of leaves (1.90 mg per g of fresh weight of leaves) were observed with the treatment GA₃ and NAA @ 50 ppm + 50 ppm, as compared to control and other treatments. This might be due to the reason that GA₃ increase the number of internodes which ultimately led towards more number of leaves production. These results were supported by findings of Bhagure and Tambe [8]. The increase in number of branches might be due to the enhanced photosynthetic activity and efficient assimilation of photosynthetic product [9].

The maximum fruit yield per plant (210.73 g), number of seeds per fruit (51.00), 100 seed weight (6.12 g) with maximum percent of germination (95.67) also recorded with the combination dose of NAA and GA₃ (50 ppm + 50 ppm) followed by treatment T₈ (Table 2). This might be due to the growth by cell division and more number of seeds per fruit. These results are in conformity with Bhagure and Tambe [7]. The beneficial effect of GA₃ and NAA and its synergistic effect on plant growth parameters have also been reported by many workers in case of okra and other vegetable crops [7,10—12]. NAA and GA₃ might have resulted into increased rate of cell division, cell elongation due to which there was an internodal length, cumulative effect of these phenomenon resulted into increased plant height, num-

ber of leaves, leaf area and fruit yield [5]. The application of growth regulators might have improved the metabolism and resulted in accumulation of photosynthates ultimately yielding more number of seeds [13]. The increase in the yield due to application of growth regulators which are capable of redistribution of dry matter in the plant there by bringing about an improvement in yield which depends not only on the accumulation of photosynthates during crop growth and development but also on its portioning in the desired storage organs [14].

References

- Roy A, Shrivastava SL, Mandal SM (2014) Functional properties of okra *Abelmoschus esculentus* L. (Moench) : Traditional claims and scientific evidences . *PI Sci Today* 1 : 121—130.
- Mihretu Y, Wayessa G, Adugna D (2014) Multivariate analysis among okra (*Abelmoschus esculentus* (L.) Moench) collection in South Western Ethiopia. *J PI Sci* 9 : 43—50.
- Gopalan C, Sastri SBV, Balasubramanian S (2007) Nutritive value of Indian Foods. National Institute of Nutrition (NIN), ICMR, India.
- Panse VC, Sukhatme PV (1987) Statistical methods for agricultural workers. ICAR, New Delhi.
- Kokare RT, Bhalerao RK, Prabu T, Chavan SK, Bansode AB, Kachare GS (2006) Effect of plant growth regulators on growth, yield and quality of okra [*Abelmoschus esculentus* (L.) Moench]. *J Agric Sci Digest* 26 : 178—181.
- Singh P, Singh V, Maurya CL, Swarnkar SK, Bajpai VP (2006) Selection of suitable growth regulator and spacing for seed yield and quality of okra [*Abelmoschus esculentus* (L.) Moench] cv KS-404. *Seed Res* 34 : 61—65.
- Bhagure YL, Tambe TB (2015) Effect of seed soaking and

- foliar sprays of plant growth regulators on physiological yield attributes of okra [*Abelmoschus esculentus* (L.) Moench] var Parbhani Kranti. Asian J Hort 10 : 31—35.
8. Bhagure YL, Tambe TB (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.
 9. Mehraj H, Taufique T, Ali MR, Sikder RK, Jamaluddin AFM (2015) Impact of GA₃ and NAA on Horticultural traits of *Abelmoschus esculentus*. World Appl Sci J 33 : 1712—1717.
 10. Kumari PM, Sekar K (2008) Effect of plant growth regulators on chlorophyll and carotenoid content of salinity stressed okra seedlings. Asian J Hort 3 : 54—55.
 11. Singh PV, Kumar J (1998) Effect of gibberellic acid as a pre-sowing seed treatment and different levels of nitrogen on germination, growth, flowering and yield of okra. Ind J Agric Res 32 : 31—36.
 12. Ambreen N, Sharma SK, Shukla YR (2010) Influence of plant growth regulators on seed yield and quality of okra. Ann Agric Bio Res 15 : 21—23.
 13. Shahid MR, Amjad M, Ziaf K, Jahangir MM, Ahmad S, Iqbal Q, Nawaz A (2013) Growth, yield and seed production of okra as influenced by different growth regulators. Pak J Agric Sci 50 : 387—392.
 14. Surendra P, Nawalagatti CM, Chetti MB, Hiremath SM (2006) Effect of plant growth regulators and micronutrients on yield and yield components in okra. Karnataka J Agric Sci 19 : 264—267.