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Effect of seed treatment with growth regulator on growth, yield and seed quality parameters of okra (*Abelmoschus esculentus* L.): CV. Utkal Gaurav

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Abstract
A field experiment was conducted, to study the Effect of growth regulator on growth, yield and seed quality parameters of okra (*Abelmoschus esculentus* L.):cv. Utkal Gaurav, was carried at Central Farm, Breeder Seed Production Unit, College of Agriculture, OUAT during Kharif season of 2015-2016, use of different growth regulators as seed treatment in 25 & 50 ppm. Among all the treatments, T_1 (GA_3 @ 50 ppm) require minimum number of days for start germination (2.07 days) and 100% germination (9.35 days), the maximum plant height was found (102.08cm), , highest test weight (7.84 g), Seedling shoot length (16.24 cm) and Days to require first flowering was found to be earliest in (34.31 days) and first harvesting (40.83 days) was recorded, among the growth regulator maximum fruit weight (15.09 g), dry fruit weight (4.96 g) fruit yield per plot (4.48kg) and yield per hectare (89.21) was observe in T_3 (NAA @ 50 ppm).

Keywords: Effect, NAA, GA_3 yield seed quality parameter of okra.

Introduction
Okra is an annual herbaceous vegetable crop that is grown for its tender fruit often consumed as vegetable. The plant is a robust, erect, annual herb, ranging 1-2 m height, with simple leaves, which are alternate and palmately veined. It is often cross-pollinated where the natural cross pollination occurs from 8.75 – 9.61%.

Growth and yield of okra depend upon various factors including seed quality, nutrition, climatic conditions and cultural practices but chemical substances like plant growth regulators can bring changes in the phenotypes of plants and affect growth, either by enhancing or by stimulating the natural growth regulatory systems from seed germination to senescence (Das and Das, 1995) [4].

Plant growth regulators are considered as new generation of agro chemicals after fertilizers, insecticides and herbicides. The use of plant growth regulators has led to intensive scientific activity for their commercial exploitation. Since, 1949 several valuable effects of different plant growth regulators have been studied on a number of horticultural crops (Khan *et al*., 2006) [7].

Although, plant growth regulators have great potential for growth improvement, but their application has to be planned sensibly in terms of optimal concentration, stage of application, species specificity and seasons. Similarly, those are inorganic substances necessary for the normal growth and development of plants and have important role in various enzymatic processes, assimilation, oxidation and reduction reactions and help in increasing the biomass and pod yield. Hence the present investigation is done to study the effect of growth regulators in growth, yield, and seed quality of okra.

Material and methods
The experiment was conducted during kharif season 2015-16 was carried at Central Farm, Breeder Seed Production Unit, College of Agriculture, OUAT. The experiment was laid out in Randomized Block Design with three replications and ten treatment combinations involving plant growth regulators viz., Naphthalene Acetic Acid (NAA), Gibberellic Acid (GA_3), Indole-3-butyric acid (IBA), Triacontanol and indol buteric acid each at different concentrations applied as seed treatment. The seeds of okra were sown in the main field with recommended

package of practices. Observations are collected on the growth of crop in ten randomly selected plants in a each plot and treatment.

Treatment details given are below.

T_1 = Seed treatment with 50 ppm GA_3
T_2 = Seed treatment with 25 ppm GA_3
T_3 = Seed treatment with 50 ppm NAA
T_4 = Seed treatment with 25 ppm NAA
T_5 = Seed treatment with 50 ppm IBA
T_6 = Seed treatment with 25 ppm IBA
T_7= Seed treatment with 50 ppm Triacontanol
T_8 = Seed treatment with 25 ppm Triacontanol
T_9=Water soaked Seed
T_{10} = Control dry seed

Effect of growth regulators on growth parameters of okra CV. Utkal Gaurav

Among the treatments, T_1 (GA_3 @ 50 ppm) require minimum number of days for start germination (2.07 days) and 100 % germination (9.35 days), which was followed by T_5. Similar result was reported by Dhoran & Gudadhe (2012) [6], where GA_3 was highly effective of germination in Asparagus seeds. GA_3 increases the activity of hydrolytic enzymes during germination process. Hydrolytic enzymes get diffused into endosperm, where they catalyse the digestion of stored food material into sugar amino acid etc. these product are used during germination and seedling emergence (Sinha 2014) [16].

The maximum plant height was found (102.08cm) in T_1 (GA_3 @ 50 ppm) they sows superior over the other treatment and control. Similar result was reported by Naruka and Paliwal (1999) [9]. This increase in plant height is due to its effect on stem elongation by rapid cell elongation and multiplication of cells in sub-apical meristem. The rapid growth that occurs is a result of both the greater number of cells formed and elongation of individual cells. The increase in plant height by GA_3 application has also been reported by Sorte *et al.* (2001) [20] in brinjal, Natesh *et al.* (2005) [10] in chilli.

Days to require first flowering was found to be earliest in (34.31 days) and first harvesting (40.83 days) was recorded in the T_3 (NAA @ 50 ppm), which was followed by T_1.(GA_3 @ 50 ppm). Similar result was reported in Chandiniraj *et al.* (2016) [3]. The increased synthesis of auxin in the root tissue by their enhanced activity due to the application of NAA and their simultaneous transport to the axillary buds would have resulted in a better sink for the mobilization of photo-assimilates at a faster rate. This would have helped in the early transformation from the vegetative phase to reproductive phase. The induction of early flower bud initiation might be influenced by narrowing of the significant accumulation of carbohydrates. The result on earliness in flowering in this experiment goes with the reports by Singh and Mukherjee (2000) [18] in chilli. Similar result was confirmed by Deshmukh (2010) [5] in chilli.

Table 1: Effect of growth regulator as seed treatment on growth parameters of okra cv. Utkal Gaurav

Treatment	Days to start germination	Days to 100 per cent germination	Final height (cm)	Days to first flowering	First harvesting (days)
T_1 GA_3 @ 50 ppm	2.07	9.35	102.08	34.68	42.68
T_2 GA_3 @ 25 ppm	2.47	11.57	99.83	34.97	43.43
T_3 NAA @ 50 ppm	2.57	12.14	100.24	34.31	40.83
T_4NAA @25 ppm	2.89	13.37	99.25	35.25	42.93
T_5 IBA @ 50 ppm	2.21	10.00	98.25	36.46	43.30
T_6 IBA @ 25 ppm	2.34	11.57	96.04	36.75	44.14
T_7 Tricontanol @ 10 ppm	2.67	12.69	95.60	36.42	43.78
T_8Triacontanol @ 5 ppm	3.05	13.65	95.22	37.17	44.78
T_9 water soaked	3.51	14.34	93.28	38.82	46.25
T_{10} Control dry seed	3.67	15.00	91.50	38.51	46.68
Mean	2.75	12.37	97.13	36.33	43.88
SEm±	0.13	0.63	0.86	0.80	0.69
CD 5%	0.39	1.86	2.56	2.39	2.06

Effect of growth regulator on yield parameters of okra cv. Utkal Gaurav.

Fruit girth and fruit length was significantly influenced by different growth regulator treatments. Maximum fruit length (15.32 cm) and fruit girth (6.37 cm) was reported T_1 (GA3 @ 50 ppm), which was followed by T_3. Similar result was observed in Patil and Patel (2010) [11] where maximum fruits girth and fruit length was higher in GA_3 treatment followed by NAA. The increase in the size of fruit i.e. length and diameter may be a result of cell enlargement and cell elongation, which is caused by the supply of growth regulators within the plants. These results were supported by Singh and Kumar (1998) [15] and Pawar *et al*. (1977) [13].

Among the growth regulator maximum fruit weight (15.09 g), dry fruit weight (4.96 g) fruit yield per plot (4.48kg) and yield per hectare (89.21) was observe in T_3 (NAA @ 50 ppm). Similar result was observed in Prasad *et al*. (2013) [12]. It is a well-established fact by several workers that increased yield is product of increased yield parameters like fruit length, width and number of seeds. The increased yield with NAA is due to greater mobilization of reserved food materials to fruit and seed, which ultimately increase the fruit length, width and number of seeds. Similar results were reported by Kishan *et al.* (2001) [8]. These results are in conformity with the finding of Akhtar *et al*. (1996) [1], Soha *et al*. (2009) [19].

Table 2: Effect of growth regulator as seed treatment on yield parameters of okra cv. Utkal Gaurav.

Treatment	Fresh fruit weight (g.)	Dry fruit weight (g.)	Number of fruit per plant	Fruits length (cm)	Fruit girth (cm)	Fruit yield/plot (kg)	Fruit yield (q/ha)
T_1 GA_3 @ 50 ppm	14.65	4.71	13.04	15.32	6.37	4.32	86.05
T_2 GA_3 @ 25 ppm	14.28	4.42	12.54	14.14	6.14	4.20	83.62
T_3 NAA @ 50 ppm	15.09	4.96	14.10	14.56	6.28	4.48	89.21
T_4 @ NAA 25 ppm	14.73	4.52	12.60	13.89	6.22	4.24	84.44

T_5 IBA @ 50 ppm	13.44	4.40	12.13	13.93	5.45	4.17	82.99
T_6 IBA @ 25 ppm	12.78	4.17	11.80	13.82	5.97	4.07	81.15
T_7 Tricontanol @ 10 ppm	12.33	4.36	12.03	13.20	6.09	4.14	82.46
T_8Triacontanol @ 5 ppm	12.13	4.21	11.77	13.25	5.85	4.06	80.81
T_9 water soaked	11.98	4.13	10.66	13.06	5.40	3.99	80.57
T_{10} Control dry seed	11.47	4.03	10.47	11.56	5.36	3.96	79.02
Mean	13.29	4.39	12.11	13.67	5.91	4.16	83.03
SEm±	0.28	0.03	0.32	0.39	0.09	0.05	1.44
CD 5%	0.84	0.10	0.96	1.154	0.28	0.15	4.27

Effect of growth regulator on seedling parameters of okra cv. Utkal Gaurav.

Among the growth regulators, highest test weight (7.84 g), germination percentage (94.67 per cent), Seedling shoot length (16.24 cm), fresh seedling weight (6.35 g), seedling dry weight (29.50 mg) was observed in T_1 (GA_3 @ 50 ppm), which was followed by T_3 Similar result was reported in Ravat and Makani (2015) [14]. The increase in seed quality parameters obtained due to spraying of (GA_3 @ 50 ppm) might be due to higher percentage of bolder seeds coupled with the higher test weight of seeds and due to increased translocation and assimilation of photosynthates from source to the sink (seeds). Similar findings were also reported by Balakumar & Balsubramanian (1988) [2], Singh and Lal (1995) [17].

Table 3: Effect of growth regulator as seed treatment on seedling parameters of okra cv. Utkal Gaurav.

Treatment	Test weight (g)	Germination per cent	Seedling shoot length (cm)	Fresh Seedling weight	Seedling dry weight (mg.)
T_1 GA_3 @ 50 ppm	7.84	94.67	16.24	6.35	29.50
T_2 GA_3 @ 25 ppm	7.35	93.35	15.27	5.75	25.57
T_3 NAA @ 50 ppm	7.68	90.68	15.69	6.22	26.60
T_4 NAA @ 25 ppm	6.88	88.54	15.32	5.81	25.43
T_5 IBA @ 50 ppm	7.54	91.38	15.02	5.83	23.27
T_6 IBA @ 25 ppm	6.67	89.15	14.95	5.68	24.03
T_7 Tricontanol @ 10 ppm	6.97	87.82	14.57	5.62	22.30
T_8Triacontanol @ 5 ppm	6.53	86.92	14.34	5.58	21.40
T_9 water soaked	6.22	85.64	13.75	5.52	20.40
T_{10} Control dry seed	5.33	81.00	13.70	4.75	19.40
Mean	6.90	88.92	14.88	5.71	23.79
SEm±	0.21	1.03	0.25	0.09	0.57
CD 5%	0.63	3.05	1.03	0.27	1.70
CD 1%	-	4.17	0.75	0.37	2.33

Conclusion

It can be concluded that use of seed treatment with NAA @ 50 ppm (T_3) is most efficient in improving the yield quality parameter and Seed quality parameter i.g. test weight, germination percentage, fresh seedling weight etc. was enhance the use of GA3 @ 50 PPM (T_1).

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