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YIELD AND QUALITY IMPROVEMENT IN OKRA THROUGH DIFFERENT AGRO-CHEMICALS

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ABSTRACT

The investigation was undertaken during *zaid* and k*harif* season of 2013 at the Horticulture Farm of Rajasthan College of Agriculture, Udaipur to study the effect of pre sowing and foliar application of agro-chemicals on okra cv. Arka Anamika. The treatments consisted of 3 pre sowing seed treatments *i.e.*, P_0 (control), P_1 (water soaking for 12 hrs), P_2 (GA_3 50 ppm for 12 hrs) and 5 foliar sprays comprising T_0 (control), T_1 (GA_3 60 ppm), T_2 (NAA 40 ppm), T_3 (urea 1.5 %), T_4 (borax 0.5 %) applied 40 days after sowing. Seed treatment with GA_3 @ 50 ppm resulted in maximum germination percentage, seedling vigour, early flowering, number of fruits, fruit weight, fruit length, yield per plant and yield per hectare (155.62 & 222.31 q) during *zaid* and *kharif* season, respectively. Under the foliar spray treatments early flowering (38.04 & 39.08 days), maximum number of fruits per plant, fruit weight, fruit length, yield per plant and yield per hectare (162.82 & 229.56 q) was recorded with NAA @ 40 ppm during *zaid* and *kharif* season, respectively. Pre sowing seed treatment with GA_3 @ 50 ppm (12 hrs soaking) and foliar spray with NAA @ 40 ppm (40 DAS) gave better response during both the seasons.

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INTRODUCTION

Okra [*Abelmoschus esculentus* (L.) Moench.] is an important vegetable crop of Malvaceae family, which supplies higher nutrition (carbohydrates, fats, protein, minerals and vitamins) in our diet. Okra is a fast growing annual which has captured a prominent position among the vegetables in India. It is a multiple use crop. It is grown practically in all agro-ecological zones of India mainly for its immature fruits which are eaten as cooked vegetable. Dried seeds are nutritious food. It contains upto 20% protein and the fibre from okra canes is a possible paper pulp source (Choudhary *et al.,* 2015). In the northern plains of India, okra is grown mainly in two seasons *i.e.* summer and rainy in different agro-climatic regions. In India, total area under okra crop is 533 thousand hectare and produce 6346 thousand tons with average productivity of 11.9 t/ha (Anonymous, 2014). Owing to increasing population and consciousness about health, the demand of vegetable crop okra is increasing. There are several factors responsible for production and productivity of the crop. The use of agro-chemicals has been proved revolutionary in increasing production of horticultural crops as seed priming and foliar spray application.

To increase the yield, application of major and micronutrients is helpful. Now a day's plant growth regulators have been tried to improve growth and ultimately yield. (Chaurasiya *et al.,* 2014) Among the growth regulators, auxin causes enlargement of plant cell and gibberellins stimulates cell division, cell enlargement or both (Nickell, 1982). Foliar spray of agro-chemicals have been found effective in increasing vegetative growth, early fruiting, yield and quality of fruits in many vegetables (Ramu and Muthuswamy, 1964). NAA and GA_3 are being used in many vegetables crops at various stages of development for increasing growth and yield by way of cell division and differentiation. Nitrogen plays a vital role in the synthesis of chlorophyll as well as amino acids which contribute to the building units of protein, thus influence the growth of the plant ultimately, enhancing the height of the plant. Among nitrogenous fertilizers, urea is highly suitable for foliar application because of its high water solubility, early and quickly absorption by plant tissues. Similarly, boron is involved in the transportation of carbohydrates and DNA synthesis in meristem. Boron deficiency exhibit internal necrosis in fruit with brown coloration near the surface of the seed, fruits remain small, leaves exhibit intervienal chlorosis and abscise early and their apexes die back (Singh, 2007). Keeping in view above facts, the present study was carried out with pre sowing seed treatments and foliar sprays of agro-chemicals in okra during *zaid* and *kharif* season for getting higher growth, yield and quality of crop.

MATERIALS AND METHODS

The okra cv. Arka Anamika was grown in bed size of 4.95 x 3.15 m with uniform plant spacing of 45 cm x 15 cm at the Horticulture Farm of Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur during *zaid* and k*harif* season of 2013. The experiment consisted of 3 pre sowing treatments comprising P_0 (control), P_1 (water soaking of seeds for 12 hrs), P_2 (GA_3 50 ppm for 12 hrs) and 5 foliar spray treatments comprising T_0 (control), T_1 (GA_3 60

ppm), T_2 (NAA 40 ppm), T_3 (urea 1.5 %), T_4 (borax 0.5 %) applied 40 days after sowing. These treatments and their combinations were evaluated under one way analysis of variance replicated thrice with adopting uniform cultural schedules during the experimentation. The observations were per cent germination, growth attributes (seedling vigour & plant height), yield attributes (days taken to flower initiation, number of fruits per plant, yield per plant and yield per hectare) and physico-chemical attributes (fruit weight, fruit length, chlorophyll and dry matter content) as well as B:C ratio during *zaid* and *kharif* season. The seed germination percentage was calculated by counting the number of germinated seedlings out of 500 counted seeds at 15 DAS and seedling vigour was calculated by multiplying germination percentage and seedling length (cm) and divided by 100. B:C ratio was calculated by dividing net return to total cost of cultivation of respective treatments. The standard method of analysis of variance technique appropriate to the Randomized Block Design (R.B.D.) as described by Panse and Sukhatme (1985) was used.

RESULTS AND DISCUSSION

The present investigation showed that the pre sowing seed treatment and foliar spray treatments significantly increased the germination percentage, seedling vigour, plant height and decreased the days taken to flower initiation. Under pre sowing seed treatments, GA_3 proved to be better for all the growth characters over rest of the treatments. Seed treatment with GA_3 @ 50 ppm gave the highest germination percentage (75.62 and 89.91 %), maximum plant height (73.44 and 102.56 cm) and early flower initiation (37.89 and 38.75 days) in okra during the *zaid* and *kharif* seasons, respectively (Table 1). Increased germination might be due to that GA_3 have stimulated the amylase enzyme activities causing starch to convert in sugar. Besides, by weakening the seed coat and allowing absorption of water it facilitated the emergence of root tip, which might have led to increased germination. The present findings are in accordance with the results of Patil and Patel (2010), Dhage *et al.* (2011) and Bhagure and Tambe (2013)

Table 1: Response of okra cv. Arka Anamika to pre sowing and foliar application of agro-chemicals during *zaid* and *kharif* seasons

Treatments	Plant height (cm)		Days to flower initiation (days)		Number of fruits per plant		Mean fruit weight(g)	
	Zaid	*Kharif*	*Zaid*	*Kharif*	*Zaid*	*Kharif*	*Zaid*	*Kharif*
A. Presowing								
P_0 (control)	57.49	93.58	40.80	41.84	11.98	13.89	8.17	10.05
P_1 (water soaking of seeds for 12 hrs)	68.71	98.29	39.07	40.41	12.23	14.32	8.25	10.12
P_2 (GA_3 50 ppm for 12 hrs)	73.44	102.56	37.89	38.75	12.57	14.73	8.36	10.19
SEm+	0.542	0.760	0.154	0.106	0.085	0.098	0.031	0.036
CD (P=0.05)	1.569	2.201	0.446	0.308	0.247	0.285	0.091	0.105
B. Foliar spray								
T_0 (control)	63.91	94.79	40.47	41.34	11.83	13.73	7.42	9.22
T_1 (GA_3 60 ppm)	69.38	101.48	39.48	40.93	12.12	14.30	8.32	10.19
T_2 (NAA 40 ppm)	66.48	97.21	38.04	39.08	12.69	14.54	8.66	10.55
T_3 (urea 1.5 %)	67.49	100.03	38.18	39.84	12.38	14.53	8.52	10.41
T_4 (borax 0.5%)	65.47	97.19	40.11	40.48	12.28	14.45	8.39	10.21
SEm +	0.699	0.981	0.199	0.137	0.110	0.127	0.040	0.047
CD (P=0.05)	2.026	2.841	0.576	0.398	0.319	0.367	0.117	0.136

Germination (%): In *zaid* season 65.56 (P_0), 71.89 (P_1) & 75.62 (P_2) and in *kharif* season 75.85 (P_0), 83.69 (P_1) & 89.91 % (P_2); Seedling vigour index: In *zaid* season 14.18 (P_0), 16.99 (P_1) & 18.86 (P_2) and in *kharif* season 20.12 (P_0), 24.57 (P_1) & 27.63 (P_2)

Table 2: Response of okra cv. Arka Anamika to pre sowing and foliar application of agro-chemicals during *zaid* and *kharif* seasons

Treatments	Mean fruit length (cm)		Chlorophyll content (%)		Dry matter content (mg g^{-1})		Yield per ha		B:C ratio	
	Zaid	Kharif	Zaid	Kharif	Zaid	Kharif	Zaid	Kharif	Zaid	Kharif
A. Presowing										
P_0 (control)	40.80	41.84	1.64	1.73	17.33	18.32	145.24	207.06	1.80	1.88
P_1 (water soaking of seeds for 12 hrs)	39.07	40.41	1.66	1.75	17.77	18.76	149.57	214.88	1.89	1.99
P_2 (GA_3 50 ppm for 12 hrs)	37.89	38.75	1.71	1.79	18.17	19.16	155.82	222.31	1.98	2.07
SEm+	0.154	0.106	0.016	0.017	0.180	0.181	2.538	2.492	-	-
CD (P=0.05)	0.446	0.308	0.047	0.050	0.521	0.523	7.352	7.219	-	-
B. Foliar spray										
T_0 (control)	40.47	41.34	1.49	1.58	16.08	17.07	130.06	187.68	1.51	1.61
T_1 (GA_3 60 ppm)	39.48	40.93	1.71	1.80	16.56	17.55	149.38	213.42	1.86	1.94
T_2 (NAA 40 ppm)	38.04	39.08	1.70	1.79	16.93	17.92	162.82	229.56	2.12	2.17
T_3 (urea 1.5 %)	38.18	39.84	1.76	1.85	19.94	20.94	156.21	224.43	2.01	2.11
T_4 (borax 0.5%)	40.11	40.48	1.69	1.78	19.28	20.26	152.58	218.65	1.87	1.96
SEm +	0.199	0.137	0.021	0.022	0.232	0.233	3.276	3.217	-	-
CD (P=0.05)	0.576	0.398	0.061	0.064	0.673	0.675	9.492	9.320	-	-

who reported highest germination percentage, plant height and minimum days taken to flower initiation with GA_3 in okra. Among the foliar spray treatments, spray of GA_3 @ 60 ppm gave the maximum plant height. This might be due to that GA_3 has most important primary site of action as the cell enlargement is stimulated in the shoot apex specially more in basal maristematic cells from which large files of cortex and pith cells develop (Sachs, 1965). NAA @ 40 ppm resulted in the earliest flower initiation because they remained physiologically more active to build up adequate food reserves resulting in better growth and development of the plants (Srivastava and Sachan, 1971).

The yield attributes *i.e.,* number of fruits, fruit weight, fruit length, yield per plant and yield per hectare were significantly influenced by the pre sowing seed treatments and foliar spray treatments during *zaid* and *kharif* seasons. Under pre sowing seed treatments, GA_3 @ 50 ppm again proved to be better for all the above yield attributes (Vijayraghavan, 2000). Among the foliar spray treatments, NAA @ 40 ppm proved to be better for above yield attributes as compared to rest of the treatments probably due to the fact that NAA was physiologically more active to enhance the cell metabolism which formed the more complex compounds. These complex compounds are responsible for building up new tissues and are associated in a number of metabolic processes related to supply of adequate food, resulting in better growth and development of the plant which indirectly enhanced the yield attributes. The present findings were accordance with the results of Surendra *et al*. (2006) with NAA @ 40 ppm in okra and Bhalekar *et al*. (2009) with NAA @ 20 ppm foliar spray in chilli cv. Phule Jyoti. Shahid *et al*. (2013) observed higher yield and dry pod weight in okra with combined application of GA_3 and NAA @ 200 ppm.

Pre sowing seed treatment with GA_3 50 ppm resulted in maximum dry matter (18.17 & 19.16 %) and chlorophyll content (1.71 & 1.79 mg/g) that might be due to the improved nutritional environment in the rhizosphere as well as its utilization in the plant system, which enhanced translocation to reproductive structures *i.e.,* fruits and other plant parts. The results are in accordance with the findings of Munda *et al*. (2000) in okra cv. Prabhani Kranti with GA_3 @ 100 ppm. Under the foliar spray, application of urea @ 1.5 % enhanced the chlorophyll (1.76 & 1.85 mg/g) and dry matter content (19.94 & 20.94 %) during both the seasons (Table 2), respectively which might be due to more availability of nitrogen to the plant. Higher nitrogen content in fruits might be due to increased activity of nitrate reductase (NR) in the synthesis of protein in fruit because it is a primary component of amino acid, which is the building block of protein molecules. Simultaneously, increased nitrogen supply resulted in vigorous vegetative growth and increased chlorophyll content which together accelerate the photosynthetic rate and thereby increased the supply of carbohydrate to plant which led to higher dry matter and chlorophyll content (Jones and Embleton, 1965). Maximum benefit : cost ratio of 1.98 and 2.07 : 1 was recorded by pre sowing seed treatment with GA_3 @ 50 while foliar spray of NAA @ 40 ppm resulted in the highest benefit: cost ratio of 2.12 and 2.17 : 1 during *zaid* and *kharif* season, respectively. Mandal *et al*. (2012) also obtained highest benefit : cost ratio in okra with the spray of NAA @ 75 ppm.

Thus, pre sowing seed treatment with GA_3 @ 50 ppm and then foliar spray of NAA @ 40 ppm at 40 days after sowing gave better growth, yield and satisfactory quality as well as higher B:C ratio during both the season *i.e., zaid* and *kharif* in okra.

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