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Effect of Different Doses of NPK and Various Bio-fertilizers on Floral Characters and Yield Attributes in Okra

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ABSTRACT

An investigation was conducted at the Horticulture Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, U. P. in 2016 to find out effect of different doses of NPK and various bio-fertilizers on floral characters and yield attributes in okra. The experiment was laid out in randomized block design comprising thirteen treatment combinations and three replications. The treatments comprised of NPK, Azospirillum, PSB and VAM including control. Result raveled that under floral characters, 100% RDF + VAM resulted minimum days to 1st (39.60) and 50% flowering (42.20) and for yield attributes minimum days to 1st edible fruit harvesting (46.60) was recorded under 100% RDF + VAM and 100% RDF + PSB recorded for maximum fruit length (11.56 cm) whereas, maximum fruit diameter (1.92 cm), fresh fruit weight (14.20 g), number of fruits/plant (18.80), fruit yield/plant (266.96 g) and maximum fruit yield/hectare (131.83 q) was recorded under 100% RDF + Azospirillum.

Key words: *Azospirillum, Randomized block design, NPK, Okra, PSB and VAM.*

INTRODUCTION

Okra belongs to family Malvaceae. There are two cultivated types of okra *Abelmoschus esculentus*, (L.) Moench and *Abelmoschus caillei*. Okra is originated probably from South East Asia and it is popular in West Africa, Brazil, Philippines, Thailand and India. Okra is a warm season vegetable crop and it grows best in hot summer with minimum and maximum temperatures of 18^0C and 35^0C respectively[12]. In India it is grown during summer and rainy season. It is extensively grown for its immature green fruits. Okra fruits are used as vegetable in India, Brazil, West Africa and many other countries. After harvesting fruits can be easily transported in bulk and stored for few days without much loss of quality. Okra seeds are also good sources of quality edible oil and protein. The dry seeds of okra contain 14-23% of edible oil and 21-25% of protein[14]. The ripe seeds of okra are used as a substitute for coffee in many countries, particularly in Turkey. The seed cake can also used as an animal feed. The dry fruit shell and stem containing crude fiber are suitable to manufacture paper and card board. The root and stem are useful for clearing cane juice[11].

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There are several types of biofertilizers such as nitrogen fixers like *Rhizobium, Azospirillum, Azotobacter,* Blue Green Algae and *Azolla,* phosphorus solubilizers include bacterial genera like *Pseudomonas, Rhizobium, Bacillus, Agrobacterium, Flavobacterium, Erwinia and Micrococcus* and fungi, and phosphorus absorbers (Mycorrhiza). Use of biofertilizers and organic manure in agriculture is becoming popular now a day not only in order to minimize the cost of chemical fertilizers but also to reduce the adverse effects of chemical fertilizers on soil and plant environment and to ensure more crop productivity. Biofertilizers have been identified as alternatives to chemical fertilizers to increase soil fertility for crop production in sustainable farming. Naidu *et al.*[8] concluded that significant increase of microbes in soil was found with application of manures, vermicompost and biofertilzers. Inoculation with diazotrophs (*Azospirillum, Azotobacter* and PSB) in okra helped fixing atmospheric nitrogen; increased phosphate availability produced growth promoting and antifungal substances and finally increased the total yield.

MATERIAL AND METHODS

The present investigation was carried out at the Horticultural Research Farm, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University Varanasi, U. P. during the year 2016 in the month of May-June to know the effect of different doses of NPK and various biofertilizers on floral characters and yield attributes in okra with cultivar Kashi Kranti. The experiment was laid out under randomized block design with three replications. The experiment consisted of 13 treatments *viz.* T_0-Control, T_1-50% NPK, T_2-50% NPK + *Azospirillum*, T_3-50% NPK + PSB, T_4-50% NPK + VAM, T_5-75% NPK, T_6-75% NPK + *Azospirillum*, T_7- 75% NPK + PSB, T_8-75% NPK + VAM, T_9-100% NPK, T_{10}-100% NPK + *Azospirillum*, T_{11}-100% NPK + PSB and T_{12}-100% NPK + VAM. Obtained findings were analyzed statistically for interpretation of results.

RESULTS AND DISCUSSION

The results obtained on both floral characters and yield attributes are presented in Table 1. The minimum days to 1st flowering (39.60) was recorded under T_{12} followed by T_{10} (39.67) whereas, maximum days to 1st flowering (42.93) was recorded under T_1. It was observed that days to 1st flowering decreased as the dose of fertilizers was increased. Biofertilizers treated plot show superiority over solely inorganic fertilizer application. This could be due to nitrogen and other inputs like biofertilizers which encouraged the differentiation of bud resulting in earlier flowering. Similar results were also reported by Mal *et al.*[7] and Prabhu *et al*[10]. In control where no fertilizer was applied, probably due to the nutrient stress resulting in late flowering. T_{12} resulted minimum days to 50% flowering (42.20) followed by T_{10} (42.27) (42.30). While, maximum days to 50% flowering (47.47) was recorded under control. Pattern of days to 50% flowering was almost similar to days to 1st flower appearance. Reason behind the earliest 50% flowering in higher dose of fertilizer and biofertilizer treated plots as compared to sole inorganic fertilizer application might be better mobilization and supply of nutrients. Minimum days to 50% flowering was observed with VAM supplemented with recommended NPK might be due to fact that VAM enhances phosphorus uptake as phosphorus enhances development of reproductive parts stimulates blooming. The minimum days to 1st edible fruit harvesting (46.60) was recorded under T_{12} followed by T_{10} (46.67), Whereas, T_1 reported for maximum days to 1st edible fruit harvesting (49.17). Earliest harvesting was observed in treatment receiving 100% RDF + VAM as compared to biofertilizers. It might be due to fact VAM mobilizes phosphorus from deeper layer thus better uptake of phosphorus enhances flowering leads to earliest fruiting. Similar finding were obtained by Alkaff and

Hassan[1].The maximum fruit length (11.56 cm) was recorded in T_{10} followed by T_{11} (10.84 cm). The minimum fruit length (8.57 cm) was recorded with control plants. Fruit length was increased with increased application of NPK. This reflects that more dose of fertilizer for better pod length. This might be attributed to the increased availability of NPK and water at the critical stages of the crop growth resulting early establishment, vigorous growth and development of plants leading to longer fruits. Similar results was reported by Mal *et al.*[7] and Anjum and Amjad[3]. Among the treatments, maximum fruit diameter (1.92 cm) was recorded under T_{10} followed by T_{11} (1.88 cm). Whereas, the minimum fruit diameter (1.70 cm) was recorded under control. Maximum fruit diameter was observed under treatment 100% RDF + *Azospirillum.* It might be due to greater supply of nutrients that have increased the production, translocation and accumulation of photosynthates as *Azospirillum* fixes nitrogen and sufficient nitrogen supply improves photosynthetic activity of the plant, thus producing greater fruit diameter. Higher value in fruit girth of okra observed due to integrated application of fertilizers by Naidu *et al*[8]. Similar results were revealed by Singh *et al.*[13] and Mal *et al*[7]. Treatment T_{10} resulted maximum fresh fruit weight (14.20 g) followed by T_{11} (13.60 g), though minimum fresh fruit weight (10.10 g) recorded under control. As fruit length and diameter was maximum in treatment 100% RDF + *Azospirillum,* similarly fresh fruit weight was also recorded maximum under the same treatment. This might be due to enhancement of uptake of water and nutrients by *Azospirillum.* Thus increased photosynthetic area and translocation of photosynthates in plants which subsequently increases the fresh fruit weight. Sahu *et al.*[11], Anisa *et al.*[2] and Bahadur and Manohar[4] also found the similar results while experimenting with okra. Bashan *et al.*[5] also reported that inoculation of *Azospirillum* resulted in an increase in plant yield in tomato. The maximum number of fruits/plant (18.80) was recorded under T_{10} followed by T_{11} (18.13) while, minimum number of fruits/plant (15.83) was recorded under control. An increase in number of fruits/plant was noticed with the application of higher levels of NPK. The maximum number of fruits per plant was produced by plant receiving 120 Kg/ha nitrogen[6]. This may be due to vigour of plant and more number of leaves by the application of higher dose of fertilizers, while less number of pods per plant might be due to the poor nutritional status of control treatment. Similar results were also revealed by Singh *et al.*[13] and Anisa *et al*[2]. Among the treatments, maximum fruit yield/plant (266.96 g) was recorded under T_{10} followed by T_{11} (246.61 g) while, T_1 resulted for the minimum fruit yield/plant (159.92 g). Higher yield was observed under treatments with higher NPK dose integrated with biofertilizers as compared sole application NPK. This might be due to increased various endogenous hormonal levels which in turn enhanced the pollen germination and tube growth[9]. This have stimulated the plants to produce productive flowers i.e. more number of fruits ultimately resulting in increased yield. Maximum fruit yield/hectare (131.83 q) was recorded under T_{10} followed by T_{11} (121.78 q), minimum fruit yield/hectare (78.97 q) was noticed under control. Singh *et al.*[13] and Bahadur and Manohar[4] also reported at 100% RDF yield was more with *Azospirillum* as compared to VAM. The improvement in yield attributes could be because of production of growth substances like IAA and GA3 by microbial inoculants, which in turn might have increased the availability and uptake of nutrients through plant roots, thus higher yields were realized.

Table 1: Effect of different doses of NPK and various biofertilizers on floral characters and yield attributes in okra

Treatments	Days to 1st flowering	Days to 50% flowering	Days to 1st edible fruit harvesting	Fruit length (cm)	Fruit diameter (cm)	Fresh fruit Weight (g)	Number of fruits /plant	Fruit yield /plant (g)	Fruit yield /hectare (q)
T_0	42.93	47.47	49.17	8.57	1.70	10.10	15.83	159.92	78.97
T_1	42.37	47.00	48.97	9.37	1.72	10.50	16.57	173.95	85.90
T_2	42.13	46.53	48.73	9.63	1.76	10.83	16.77	181.64	89.70
T_3	41.63	46.87	48.83	9.67	1.74	10.70	16.73	179.05	88.42
T_4	41.33	45.80	48.40	9.10	1.74	10.62	16.63	176.59	87.21
T_5	40.77	45.47	47.77	10.10	1.76	11.20	16.80	188.16	92.92
T_6	40.50	44.37	47.50	10.23	1.84	12.47	17.20	214.43	105.89
T_7	40.70	45.27	47.70	10.20	1.82	11.78	17.03	200.71	99.12
T_8	40.23	43.70	47.23	10.07	1.78	11.57	16.97	196.25	96.91
T_9	39.97	43.57	46.97	10.50	1.87	12.93	17.70	228.92	113.05
T_{10}	39.67	42.27	46.67	11.56	1.92	14.20	18.80	266.96	131.83
T_{11}	39.70	42.30	46.70	10.84	1.88	13.60	18.13	246.61	121.78
T_{12}	39.60	42.20	46.60	10.80	1.88	13.23	17.77	235.11	116.10
CD 5%	1.43	1.89	1.78	0.80	0.11	1.06	0.72	8.86	4.37
S.E. (d)	0.69	0.91	0.86	0.39	0.05	0.52	0.35	4.29	2.12

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