Impact of Integrated Nutrient Management on growth, yield and quality of Okra (*Abelmoschus esculentus* (L.) Moench)

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ABSTRACT

A field experiment was conducted during the *Kharif season* of 2013 at, Vegetable Research Farm, Department of Horticulture, Allahabad School of Agriculture, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad (Uttar Pradesh) to evaluate the"Integrated nutrient management in Okra [*Abelmoschusesculentus* (L.) Moench]". The experiment was laid out in Randomized Block Design with three replications and ten treatments. Two organic sources of nutrition, vermicompost and biogen were combined with NPK fertilizers and the performance was compared with the sole chemical fertilization. Among 10 treatments under study, T_8 (75% RDF + 25% Vermicompost + Biogen) recorded maximum values for plant height (59.64 cm), T.S.S. content (2.71 %), fiber content (1.75 g), total yield per plot (1866.97 g), net return per hectare (M76915.75), cost benefit ratio (1:3.00) and also recorded minimum days (4.33 days) to 50% germination of seeds and minimum incidence of yellow vein mosaic virus effect. The highest number of fruits/plant (22.04) with the application of 75% recommended dose of fertilizers (RDF) + 25% vermicompost (T_4), length of fruits (9.18 cm) with the application of 50% RDF + 50% vermicompost + biogen (T_7), fruit weight (9.00 g) and fruit girth (5.22 cm) with the application of 25% RDF + 75% vermicompost (T_2) were observed. This study suggests that 75% RDF + 25% vermicompost + biogen are potential source for fruit yield and highest cost benefit ratio in okra.

Key worlds : *biogen, growth, NPK, Vermicompost, yield and okra.*

INTRODUCTION

Okra (*Abelmoschus esculentus* (L.) Moench) has captured a prominent position among vegetables, being native of tropical Africa. It is commonly known as okra or lady's finger in India. It is choicest fruit vegetable grown extensively in tropical and subtropical parts of the World **(Hammon and Van Sloten, 1989)** and also well distributed in the Indian subcontinent and East Asia **(Kochhar, 1986)**. Its tender green fruits are used as a vegetable and are generallymarketed in fresh state, but sometimes in canned or dehydrated form. Its dry seeds are a rich source of iodine, carbohydrate, protein, oil and vegetable curd. Seeds are also used as coffee additive or substitute **(Thamburaj and Singh, 2005)**. Dry seed of okra contains 18-20% oil

(Martin and Rhodes, 1983) and 20-23% crude proteins **(Berry, 1998)**, foliage can be used for biomass and dried stem as the source of paper pulp or fuel. Its roots are used to clean sugarcane juice to make jaggery. Okra is praised for its medicinal values, as its fruits are useful in genito urinary disorders, spermatorrhoea and chronic dysentery. Okra is polyploid having chromosome number 2n = 8x = 72 or 144, belongs to the family Malvaceae. This vegetable is basically a self-pollinated crop, though essentially self-pollinated because of its showy corolla, the possibility of cross-pollination by insects cannot be ruled out. Consequently, cross pollination to the extent of 4.0-19.0 per cent with maximum of 42.2 per cent **(Kumar, 2006)** is noticed with the insect assisted pollination. Okra is highly susceptible to frost and requires warm climate for fruit production.

In the present Indian Agriculture, keeping in view of inadequate availability of organic sources of nutrients and expected yield decline at least in the initial years, complete substitution of chemical fertilizers is not necessarily warranted. Rather organic sources should be used as partial replacement of the chemical fertilizers. Thus, a strategy for judicious combination of both organic and inorganic sources of nutrients is the most viable option for nutrient management. It will be economically viable and also help in attaining sustainability in production and maintaining soil health and environment **(Bairwa *et al.*, 2009)**. Hence, the present investigation was conducted to frame integrated nutrient management strategy for okra.

MATERIALS AND METHODS

The present investigation was conducted at Vegetable Research Farm, Department of Horticulture, SHIATS, Allahabad during 2013-14, with ten treatments viz., T_1 (100:60:50 kg NPK recommended dose of fertilizers (RDF), T_2 (25% RDF + 75% Vermicompost), T_3 (50% RDF + 50% Vermicompost), T_4 (75% RDF + 25% Vermicompost), T_5 (RDF + Biogen), T_6 (25% RDF + 75% Vermicompost+ Biogen), T_7 (50% RDF + 50% Vermicompost + Biogen), T_8 (75% RDF + 25% Vermicompost + Biogen), T_9 [100 % Biogen (alone)] and T_{10} [100 % Vermicompost (alone)]. The experiment was laid out in a Randomized Block Design with three replications. All the recommended packageof practices was followed timely for raising ahealthy good crop. The observations wererecorded on five competitive plants from eachplot on thirteen characters viz., days to 50% germination of seed, plant height (cm), number of branches per plant, number of leaves per plant, number of fruits per plant, fruit length (cm), fruit girth (cm), fresh weight of fruit (g), yield per plot (g), number of seed per fruit,

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yield per hectare (q), T.S.S.(%), fiber content(g),yellow vein mosaic virus affected plants per plot and economics of the treatments.

The entire dose of vermicompost, phosphorus, potassium and half dose of nitrogen as per treatment combination per plot were applied at the time of sowing as basal dressing. The remaining half dose of nitrogen was applied in two split doses as top dressing at 30 and 45 days of sowing, respectively. Economics was worked out on the basis of the existing values of output and inputs used. The crude fiberof the okra was determined using the standard **(AOAC, 1990)** method. The data recorded during the course ofinvestigation were subjected to statistical analysis by analysis of variance (ANOVA) technique **(Fisher, 1958)** for drawing conclusions.

RESULTS AND DISCUSSION

The minimum days (4.33 days) to 50% germination were recorded in the treatment T_8 (75% RDF + 25% Vermicompost + Biogen), while maximum days (7.33) were recorded in T_{10} [100% Vermi compost (alone)]. At 60 days after sowing the maximum plant height (59.64 cm) was observed in T_8 (75% RDF + 25% Vermicompost + Biogen) followed by (59.40 cm) in T_4 (75% RDF + 25% Vermicompost), while the minimum plant height (43.83 cm) was observed in T_9 [100% Biogen (alone)]. At 60 days after sowing the maximum plant branches (6.00) were observed in T_5 (100% RDF + Biogen) followed by (5.86) in T_9 [100% Biogen (alone)], while the minimum plant branches (5.46) were observed in T_7 (50% RDF + 50% Vermicompost + Biogen). At 60 days after sowing the maximum plant leaves (15.60) were observed in T_9 [100% Biogen (alone)] followed by (15.33) in T_{10} [100% Vermicompost (alone)], while the minimum plant leaves (14.93) were observed in T_2 (25% RDF + 75% Vermicompost). This might be due to the fact that N in readily available form vigorously activated the vegetative development of plants *(Patel et al., 2009)*. Also, application of NPK showed synergistic effect upto 100 per cent RDF by extracting the synthesis of chlorophyll and amino acid which are associated with major plant process. These results are accordance with **(Sharma *et. al.*, 2014)**, **(Ghuge *et al.*, 2015)** and **(Lal and Kumar, 2016)**.

Yield per hectare (q)

The maximum total yield per hectare (46.09 q) was observed in T_8 (75% RDF + 25% Vermicompost + Biogen) followed by (46.00 q) in T_7 (50% RDF + 50% Vermicompost + Biogen), while the minimum total yield per hectare (31.49 q) was observed in T_9 [100% Biogen (alone)]. The total yield was influenced by integrated nutrient management treatment. In organic and inorganic combinations, the nitrogenous sources applied through inorganic fertilizers might have taken care of the nutrient requirement in the early stages of growth, and in the later stages the mineralized N form organic manures are available to the plant. Hence, there was a continuous supply of nutrients resulting in higher growth and yield contributing characters in the treatments helping to record higher yield. Similar result was found by **(Sharma *et al.*, 2010)**. Moreover, the organic manures are also significant sources of major and micronutrients much needed by the plants as reported by **(Rafi *et al.*, 2002)**.

The maximum T.S.S. content (2.71%) of fruits was observed in T_8 (75% RDF + 25% Vermicompost + Biogen) followed by (2.70%) in T_4 (75% RDF + 25% Vermicompost), while the minimum T.S.S. content (2.60%) of fruits was observed in T_{10} [100% Vermicompost (alone)]. The maximum fiber content (1.75 g) in pods was observed in T_8 (75% RDF + 25% Vermicompost + Biogen) followed by (1.74 g) in T_9 [100% Biogen (alone)], while the minimum fiber content (1.63 g) in pods was observed in T_6 (25%

S.N.	Treatments	Days to 50% germination of seeds	Plant Height Days after sowing			Number of leaves Days after sowing			Number of branches Days after sowing	
			30	45	60	30	45	60	45	60
1.	Recommended dose of fertilizers (control)	6.33	22.87	52.52	58.70	7.13	12.86	15.00	4.33	5.60
2.	25% RDF + 75% Vermicompost	6	21.90	52.08	59.15	6.73	12.86	14.93	4.33	5.66
3.	50% RDF + 50% Vermicompost	6.66	22.01	49.98	56.78	6.93	12.86	15.00	4.33	5.60
4.	75% RDF + 25% Vermicompost	6	25.10	52.14	59.40	6.06	12.80	14.93	4.20	5.73
5.	100 % RDF + Biogen	5.66	25.30	50.37	58.00	6.40	12.86	15.06	4.53	6.00
6.	25% RDF + 75% Vermicompost + Biogen	5	21.99	45.78	53.68	6.53	12.86	15.26	4.40	5.66
7.	50% RDF + 50% Vermicompost + Biogen	5	21.14	47.16	54.96	6.13	13.13	15.20	4.40	5.46
8.	75% RDF + 25% Vermicompost + Biogen	4.33	23.94	52.22	59.64	6.60	12.73	15.20	4.26	5.66
9.	100 % Biogen (alone)	6	18.16	35.54	43.83	6.33	13.40	15.60	4.40	5.86
10.	100 % Vermicompost (alone)	7.33	18.39	37.47	44.96	6.80	13.33	15.33	4.40	5.60
	F-test	S	NS	S	S	NS	NS	NS	S	NS
	SE	0.69	2.25	4.03	3.83	0.46	0.29	0.25	0.08	0.16
	CD	1.45	4.73	8.48	8.05	0.97	0.61	0.53	0.17	0.34

S.N.	Treatments	T.S.S (%)	Fiber content (g)	Y. V. M. V. affected plants per plot	Yield per hectare (q)	B:C ratio
1.	Recommended dose of fertilizers (control)	2.65	1.69	7.66	35.73	1:2.4
2.	25% RDF + 75% Vermicompost	2.64	1.72	7.33	36.45	1:2.1
3.	50% RDF + 50% Vermicompost	2.68	1.68	6.66	38.29	1:2.3
4.	75% RDF + 25% Vermicompost	2.70	1.70	7.00	38.92	1:2.5
5.	100 % RDF + Biogen	2.67	1.67	6.33	40.14	1:2.7
6.	25% RDF + 75% Vermicompost + Biogen	2.66	1.63	5.33	42.00	1:2.4
7.	50% RDF + 50% Vermicompost + Biogen	2.69	1.63	5.00	46.00	1:2.8
8.	75% RDF + 25% Vermicompost + Biogen	2.70	1.75	5.00	46.09	1:3.0
9.	100% Biogen (alone)	2.66	1.74	8.33	31.49	1:2.6
10.	100% Vermicompost (alone)	2.60	1.74	8.33	33.00	1:2.0
	F-test	S	S	S		
	SE	2.65	0.07	0.40		
	CD	2.64	0.16	0.85		

RDF + 75% Vermicompost + Biogen). The inorganic fertilization treatment produced the lowest crude protein content, when compared with the other treatments. The findings get full support with the findings of **(Sammera *et al.*, 2005)**, **(Yogita and Ram, 2012)** and **(Yadav *et al.*, 2016)**.

Yellow vein mosaic virus affected plants per plot

The maximum number of yellow vein mosaic virus affected plants (8.33) per plot were observed in T_9 [100% Biogen (alone)] followed by (7.66) in T_1 (Recommended dose of fertilizers), while the minimum number of yellow vein mosaic virus affected plants (5) per plot were observed in T_8 (75% RDF + 25% Vermicompost + Biogen).

Economics of the treatments

The maximum net return per hectare (M76915.75) was observed in T_8 (75% RDF + 25% Vermicompost + Biogen) followed by (M74609.87) in T_7 (50% RDF + 50% Vermicompost + Biogen), while the minimum net return per hectare (M41610.25) was observed in T_{10} [100 % Vermicompost (alone)]. The maximum cost benefit ratio (1:3.00) was observed in T_8 (75% RDF + 25% Vermicompost + Biogen) followed by (1:2.84) in T_7 (50% RDF + 50% Vermicompost + Biogen), while the minimum cost benefit ratio (2.01) was observed in T_{10} [100 % Vermicompost (alone)].

CONCLUSION

Among the various levels of integrated nutrient management used in the experiment, the treatment T_8 (75% RDF + 25% Vermicompost + Biogen) gave the best growth, yield and quality of okra under Praygaraj agro-climatic condition when compared with control and the other treatments.

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