

Original Research Article

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Efficacy of Organic Manures and Bio-fertilizers on Yield Attributes and Yield of Okra *var.* Chameli

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ABSTRACT

Keywords

Okra, Organic manures, Bio-fertilizers, Yield attributes and yield

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A field experiment was conducted to study the 'Efficacy of organic manures and bio-fertilizers on yield attributes and yield of okra *var.* Chameli' during rainy season 2016-17 at Horticulture Farm, S.K.N. College of Agriculture, Jobner (Jaipur) with consisted of 16 treatments combinations *viz.*, organic manures (Control, FYM, Poultry Manure and Vermicompost) and bio-fertilizers (Control, *PSB*, *VAM* and *Azotobacter*) tested in randomized block design with three replications. results shows that the application of vermicompost @ 8 t ha⁻¹ and *Azotobacter* alone significantly increased the number of fruit plant⁻¹, fruit weight (g), fruit length (cm) fruit yield plant⁻¹ (g), fruit yield plot⁻¹ (kg) and fruit yield hectare⁻¹ (q) as compared to control, FYM and poultry manure. The combined application of vermicompost @ 8 t ha⁻¹ + *Azotobacter* as seed inoculation proved to be most superior treatment combination in terms of fruit weight (g), fruit yield plant⁻¹ (g), fruit yield plot⁻¹ (kg) and fruit yield hectare⁻¹ (q).

Introduction

Okra [*Abelmoschus esculentus* (L.) Moench] plant is erect, herbaceous annual green and belongs to family malvaceae. It is indigenous to tropical Africa and grown throughout the tropics and subtropics. It can be fried or cooked with necessary ingredients. The tender fruit can be cut into small pieces, boiled and served with soup. Matured fruits and stem containing crude fibres are used in the paper industry. The roots and stems are used for clearing cane juice in preparation of 'gur'. High iodine content of fruits helps to control goiter. Okra is said to be very useful against

genito-urinary disorders, spermatorrhoea and chronic dysentery (Nadkarni, 1927). The oil is used in soap and cosmetic industry, while protein is used for fortified feed preparation. The crushed seed is fed to cattle for higher milk production and the fibre is utilized in jute textile and paper industry. Okra is grown on 0.14 million hectares with the production of 0.88 million tonnes and in the India, it is grown on 533 thousand hectare with the production of 6346('000 MT) (Anonymous, 2015).

In India, the mixed farming system with livestock raising is an integral part of crop

production of Indian farmers. Farm yard manure is rich in nutrients basically using cow dung, cow urine, waste straw and other dairy wastes. The organic manure FYM not only provides nutrient to the plant but also improves the soil texture by binding effect of soil aggregates. Organic manure increases cation exchange capacity, water holding capacity and phosphate availability of the soil beside improving the fertilizer use efficiency and microbial population of soil, it reduces nitrogen losses due to slow release of nutrients (Tadesse *et al.*, 2013). Vermicompost is a slow nutrient releasing organic manure which have most of the macro as well as micro nutrients in chelated form and fulfill the nutrient requirement of plant for longer period.

Vermicompost is being a stable fine granular organic matter, when added to soil, it loosens the soil and improves the passage to the entry of air. The soil enriched with vermicompost provides additional substances that are not found in chemical fertilizers. Vermicompost is made up primarily of C, H and O and contains nutrients such as NO₃, PO₄, Ca, K, Mg, S and micronutrients which exhibit similar effects on plant growth and yield as inorganic fertilizers applied to soil (Singh *et al.*, 2008). Poultry manure is a valuable fertilizer and can serve as a suitable alternate to chemical fertilizer. Poultry manure application registered over 53 per cent increases of N level in the soil, from 0.09 per cent to 0.14 per cent and exchangeable cations increase with manure application (Boateng *et al.*, 2006). In agriculture, the main reasons for applying poultry manure include the organic amendment of the soil and the provision of nutrients to crops (Warren *et al.*, 2006). Poultry manure was readily available and in the best form for easy absorption by the plant roots, hence there was a boost in the morphological growth of the plant (Onwu *et al.*, 2014).

Bio-fertilizers liberate growth promoting substances and vitamins and help to maintain soil fertility. Phosphate solubilizing Bacteria (PSB) significantly helps in the release of this insoluble inorganic phosphate and makes it available to the plants. PSB are a group of beneficial bacteria capable of hydrolysing organic and inorganic phosphorus from insoluble compounds. P-solubilization ability of the microorganisms is considered to be one of the most important traits associated with plant phosphate nutrition. It is generally accepted that the mechanism of mineral phosphate solubilization by PSB strains is associated with the release of low molecular weight organic acids through which their hydroxyl and carboxyl groups chelate the cations bound to phosphate, thereby converting it into soluble forms. In addition, some PSB produce phosphatase like phytase that hydrolyse organic forms of phosphate compounds efficiently. PSB have been introduced to agricultural community as phosphate 'Biofertilizer' (Gupta *et al.*, 2014). Mycorrhizae are the root-symbionts which obtain their nutrients from the plant and provide mineral elements like N, P, K, Ca, S and Zn to the host plant.

This review is an attempt to explore the suppressing abilities of *Arbuscular Mycorrhizal Fungi* (AMF) against soil borne pathogens (root feeding nematodes and fungi), infecting various crops. AMF to increase the productivity of cereal crops, fruits and vegetable crops (Abbasi *et al.*, 2015). *Azotobacter* has beneficial effects on crop growth and yield through, biosynthesis of biologically active substances, stimulation of rhizospheric microbes, producing phytopathogenic inhibitors. Modification of nutrient uptake and ultimately boosting biological nitrogen fixation. The presence of *Azotobacter sp.* in soils has beneficial effects on plants, but the abundance of these bacteria is related to many factors, soil physico-

chemical (e.g. organic matter, pH, temperature, soil moisture) and microbiological properties (Jnawali *et al.*, 2015).

Materials and Methods

A field experiment entitled 'Efficacy of organic manures and bio-fertilizers on yield attributes and yield of okra [*Abelmoschus esculentus* (L.) Moench]' was conducted at Horticulture Farm, S.K.N. College of Agriculture, Jobner in randomized block design comprising of 16 treatment combinations *viz.*, organic manures (Control, FYM, Poultry Manure and Vermicompost) and bio-fertilizers (Control, *PSB*, *VAM* and *Azotobacter*) during *Kharif* season 2016.

The treatments were randomly allocated to different plots using random number table of Fisher and Yates (1963). Healthy seeds of variety Chameli were dibbled 2 cm deep maintaining uniform distance of 45 x 60 cm in two successive hills. FYM and Poultry Manure were applied in the beds as per treatments and was thoroughly incorporated in to the soil before sowing and at the time of seed sowing according to RDF of okra (102:60:60 NPK). We calculated FYM @ 24 t ha⁻¹, Poultry Manure @ 6 t ha⁻¹ and Vermicompost @ 8 t ha⁻¹ was supplied about 3-4 cm deep at the time of sowing. Application of biofertilizers was done as per treatment *Azotobacter* (200ml ha⁻¹) as seed treatment. 2-3 ml *Azotobacter* in Liquid form was mixed in one litre of water. Then seeds are soaked in this solution for 25 minutes.

PSB also applied as seed treatment @ 5g/kg seed for this 125 g of Jaggery was mixed in one litre of boiled water. Appropriate quantity (2g) of was poured in Jaggery solution separately and stirred well. The seeds were allowed to air dry in shade. *VAM* @15kg ha⁻¹ applied as soil application.

Statistical analysis

To test the significance of variance in the data obtained from the various yield attributes and yield the technique of analysis of variance was adopted as suggested by Fisher and Yates (1963) for randomized block design. Significance of difference in the treatment effect was tested through 'F' test at 5 percent level of significance and CD (critical difference) was calculated, wherever the results found significant.

Results and Discussion

Efficacy of organic manures on yield attributes

The data presented in Table 1 and depicted in Figure 1 showed that number of fruits plant⁻¹, fruit weight (g) and fruit length (15.41 cm) significantly increased under organic manures.

The maximum number of fruits plant⁻¹ (26.04), fruit weight (15.29 g) and fruit length (15.41 cm) were recorded under vermicompost (M₃), while minimum number of fruits plant⁻¹ (16.55), fruit weight (12.08 g) and fruit length were recorded under control.

The magnitude increase with vermicompost were found to be in number of fruits plant⁻¹ (57.34, 24.65 and 10.58), fruit weight (26.63, 15.20 and 9.25) and fruit length (54.59, 33.04 and 13.59) per cent more as control, FYM and poultry manure, respectively.

The beneficial effect of vermicompost on yield and yield attributes might be attributed to its ability to sustain availability of nutrient throughout the growing season. The increased balanced C: N ratio might have increased the synthesis of carbohydrates with ultimate improvement in yield and yield attributes (Kondappa *et al.*, 2009; Sharma *et al.*, 2010 and Yadav and Yadav, 2010).

Fig.1 Efficacy of organic manures and bio-fertilizers on number of fruits plant⁻¹, fruit weight (g) and fruit length (cm)

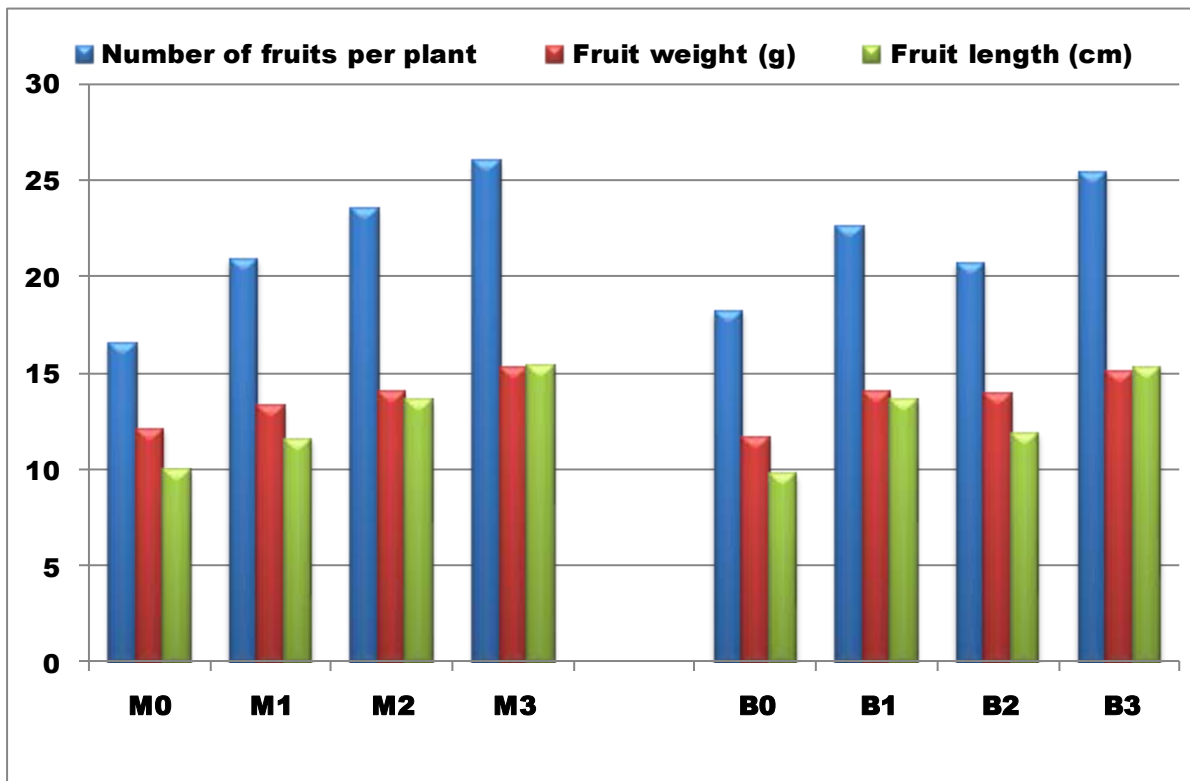


Fig.2 Efficacy of organic manures and bio-fertilizers on yield ha⁻¹ (q)

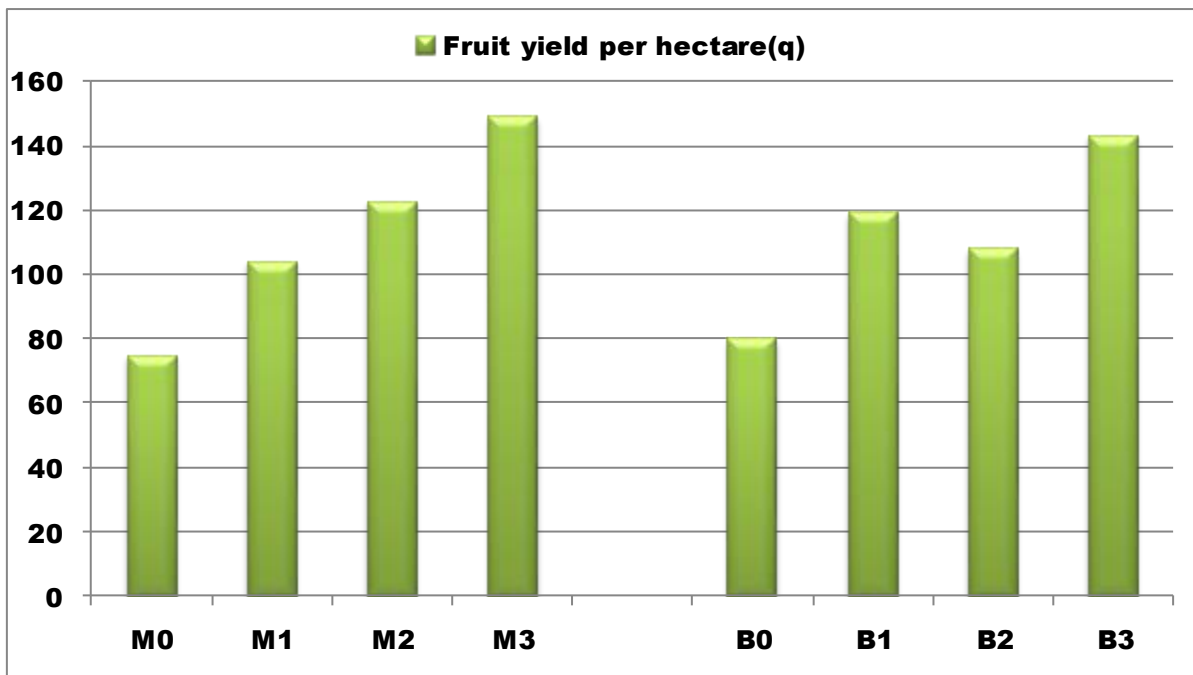


Table.1 Efficacy of organic manures and bio-fertilizers on yield and yield attributes of okra

S. No.	Treatments	Number of fruits plant ⁻¹	Fruit weight	Fruit length	Fruit yield plant ⁻¹	Fruit yield plot ⁻¹	Fruit yield ha ⁻¹	Yield picking ⁻¹
A. Organic manures								
1.	Control (M₀)	16.55	12.08	9.97	202.00	3.23	74.81	3.30
2.	FYM @ 24 t ha⁻¹(M₁)	20.89	13.27	11.58	280.99	4.50	104.07	4.71
3.	Poultry Manure @ 6 t ha⁻¹ (M₂)	23.55	14.00	13.57	330.55	5.29	122.43	5.82
4.	Vermicompost @ 8 t ha⁻¹ (M₃)	26.04	15.29	15.41	402.10	6.43	148.93	6.81
	S.Em.±	0.51	0.28	0.35	6.45	0.11	2.52	0.12
	CD (P=0.05)	1.48	0.81	1.02	18.63	0.31	7.27	0.33
B. Bio-fertilizers								
1.	Control (B₀)	18.20	11.69	9.75	216.01	3.46	80.00	3.88
2.	PSB (B₁)	22.65	14.00	13.59	321.70	5.15	119.15	5.39
3.	VAM (B₂)	20.69	13.88	11.90	291.48	4.66	107.95	4.69
4.	Azotobacter (B₃)	25.48	15.07	15.29	386.45	6.18	143.13	6.68
	S.Em.±	0.51	0.28	0.35	6.45	0.11	2.52	0.12
	CD (P=0.05)	1.48	0.81	1.02	18.63	0.31	7.27	0.33

Efficacy of organic manures on yield

Data regarding to fruit yield in okra are given Table 1 and depicted in Figure 2. The fruit yield plant⁻¹, plot⁻¹, ha⁻¹ and picking⁻¹ were significantly influenced by different organic manures. The maximum fruit yield plant⁻¹ (402.10 g), plot⁻¹ (6.43 kg), ha⁻¹ (148.93 q) and picking⁻¹ (6.81 kg) were recorded under vermicompost followed by poultry manure (330.55 g) and FYM (280.99 g) and minimum under control (202.00 g, 3.23 kg, 74.81 q and 3.30 kg). The per cent increase in fruit yield plant⁻¹ (99.06, 43.10 and 21.64), plot⁻¹ (99.05, 43.10 and 21.64) ha⁻¹, (99.05, 43.10 and 21.64) and picking⁻¹ (106.36, 44.62 and 17.01) with vermicompost (M₃) were found to be higher over M₀, M₁ and M₂, respectively. The increased yield attributes and yield with poultry manure might be because of rapid availability and utilization of nitrogen for various internal plant processes for carbohydrates production. Later on these carbohydrates undergo hydrolysis and get converted in to reproductive sugars which ultimately helped in increasing yield. These results are in accordance with the findings of Naidu *et al.*, (2002) and Meerabai *et al.*, (2007).

Efficacy of bio-fertilizers on yield attributes

A critical view of data (Table 1 and depicted in Fig. 1) revealed that application of *Azotobacter* produced significantly maximum number of fruits plant⁻¹ (25.48), fruit weight (15.07 g) and fruit length (15.29 cm), which was found to be significantly superior over treatment control, *PSB* and *VAM*. The per cent increase with *Azotobacter* found to be in number of fruits plant⁻¹ (39.99, 12.51 and 23.14), fruit weight (28.83, 7.64 and 8.55) and fruit length (56.85, 12.45 and 28.45) per cent more over control, *PSB* and *VAM*, respectively. *Azotobacter* has beneficial

effects on crop growth and yield through, biosynthesis of biologically active substances, stimulation of rhizospheric microbes, producing phytopathogenic inhibitors. The presence of *Azotobacter sp.* in soils has beneficial effects on plants, but the abundance of these bacteria is related to many factors, soil physico-chemical (*e.g.* organic matter, pH, temperature, soil moisture) and microbiological properties. Its abundance varies as per the depth of the soil profile. *Azotobacter* is much more abundant in the rhizosphere of plants than in the surrounding soil and that this abundance depends on the crop species (Jnawali *et al.*, 2015).

Efficacy of bio-fertilizers on yield

Application of different bio-fertilizers significantly influenced increased the fruit yield plant⁻¹, plot⁻¹, ha⁻¹ and picking⁻¹ (Table 1 and Fig. 2). The maximum fruit yield plant⁻¹ (386.45 g), plot⁻¹ (6.18 kg), ha⁻¹ (143.13 q) and picking⁻¹ (6.68 kg) obtained under treatment *i.e.* B₃, while minimum fruit yield (216.01 g, 3.46 kg, 80 q and 3.88 kg) was recorded under control. The per cent increase with *Azotobacter* found to be in fruit yield plant⁻¹, plot⁻¹, ha⁻¹ (78.90, 20.12 and 32.58) and picking⁻¹ (72.23, 14.08 and 42.47) per cent more over B₀, B₁ and B₂, respectively.

The improvement in yield characters in okra with inoculation of *PSB* is due to solubilization and increased availability of P from insoluble or otherwise fixed phosphorus for its plant availability (Sahu *et al.*, 2014). The beneficial effects of *PSB* along with other nutrients increased yield of crop might have resulted due to higher rate in partitioning of different reproductive structure and yield attributes which might have ultimately in turned to higher yield of the crop (Bairwa *et al.*, 2009). *VAM* inoculation in soil also significantly plays an important role in P cycling mobilization and uptake by plants,

greater root extension, higher nutrient uptake, higher photosynthesis and balanced partitioning are the main factor of significant increase in yield attributes and yield (Sidhya *et al.*, 2015).

It is also not feasible to make available the required amount of N to the plants through vermicompost alone hence, an integration of vermicompost and seed inoculation by *Azotobacter* may be one of the better options to maintain soil fertility and sustain crop productivity.

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