INFLUENCE OF DIFFERENT ORGANIC NUTRIENT MANAGEMENT PRACTICES ON GROWTH, YIELD AND ECONOMICS OF OKRA (ABELMOSCHUS ESCULENTUS L)

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Abstract - The field experiment was carried out at Organic Farming Research Centre, Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Shivamogga during 2019-2021 (two years) to evaluate the influence of different organic nutrient management practices on growth, yield and economics of Okra (Bhendi crop). There were nine treatments consisting of organic sources of nutrients evaluated in randomized block design with three replications. Among the treatments, FYM(25t/ha) + 100 per cent N equivalent vermin compost had showed better performance for plan height (75.9 cm), number of leaves per plant (37.2), number of fruits per plant (10.5), fruit weight (11.8 g/fruit) and yield per hectare (7.7 tonnes). The highest gross return (Rs. 1,99,926 ha-1) and net return (Rs. 1,07,726 ha-1). FYM (25t/ha) + 100 per cent N equivalent vermi compost treatment significantly superior over all other treatments except treatment receiving FYM (25 t/ha)+ 100 per cent N equivalent FYM for growth, yield and economics attributes.

Keywords - Okra, Organic, Nutrient management, Yield

I. INTRODUCTION

The Okra Bhendi is cultivated as one of the Popular and the consumable major vegetable crops next to tomato, Brinjal popular from its taste and various food dishes. It is a popular and principle fruit vegetable grown in India and other parts of tropical and subtropical world but in temperate regions, it is grown mainly during both during kharif and warm season. It is highly productive and usually finds a place as “nutritive vegetable crop”. Okra fruit pods are an excellent source of starch, proteins, minerals, vitamins, dietary fibres and low-fat content (Zenia and Halina, 2008). It is one of the richest sources of antioxidants mainly ascorbic acid which has been reported to successfully suppress the development and growth of tumors, inhibit inflammation and cardiovascular diseases (Somawathi et al., 2014). Several researchers have been exerted to improve the productivity of this vegetable crop. One of the improvement strategies is to look at nutritional requirement of the crop that can play a major role in it optimum yield and quality.

The indiscriminate use of chemical inputs in agriculture concerns the contamination of foods with agrochemicals and also the pollution of environment, soil and water and therefore made us to think about alternate form of agriculture to produce food free of contaminants. (Singh et al., 2017). With the popularization of organic farming at the global level, there is a constant haunt for nutritional sources and their applications to sustain the productivity of organic systems. Soil management is one of the important requirements for improving the agricultural productivity in tropics and sub-tropic soils. Organic manures constitute a dependable source of essential nutrients besides improving the soil physical, chemical and biological conditions. It is a challenging task for farmers as well as scientists to manage nutrients in organic farming systems since usage of inorganic fertilisers is strictly not permitted. The use of organic amendments to meet the nutrient requirement of crops would be an inevitable practice in the years to come for sustainable agriculture (Vishwajith and Deva Kumar, 2018). organic farming plays a vital role in maintaining biological diversity, decrease soil and ground water contamination, optimize biological productivity (Watson et al., 2002), Developing an appropriate nutrient management package that encompasses traditionally used organic amendments like farm yard manure, vermicompost becomes crucial in enhancing soil health and quality in the long run. Farm yard manure is a decomposed organic matter obtained by the action of microbial population in a warm and moist aerobic environment using cow dung, cow urine and other waste materials available from 520 backyard

cattle (Ramprasad et al., 2009). Although the organic amendments contain major nutrients in small quantities compared to the chemical fertilizers, the presence of organic carbon and growth-promoting principles like enzymes and hormones, make them a preferential choice for improving soil fertility and productivity (Bhuma, 2001). Further, few studies have documented the positive relationship of organic amendments with the growth, yield, and quality of fruits (Christo et al., 2011; Sarhan et al., 2011; Agbo et al., 2012).

Production technology for organic okra primarily involves three management practices viz., efficient crop management, appropriate nutrient management and effective plant protection measures. Among them nutrient management plays important role. In addition to organic manures such as FYM, recycling of organic wastes through composting, green manures and biological inputs like vermicompost and bio-fertilizers etc., constitute important components for plant nutrient management in organic farming and it is indispensable to identify the better source of nutrient and quantity to meet the nutrient requirement of field bean. The main objective of the present investigation was to evaluate the effect of different nutrient management practices on plant growth, yield and soil nutrient status of okra crop along with the economics of various treatment combinations.

II. MATERIALS AND METHODS

A field experiment was conducted at Organic Farming Research Centre, Navile, Shivamogga, Karnataka (130 58' 30" N and 750 34' 37" E) during Kharif season two consecutive years from 2019-20 to 2020-21, to study the Effect of different organic nutrient management practices on growth, yield and economics of Okra. The soil of experimental site was slightly acidic in reaction (pH 5.89) with normal electrical conductivity (0.01 dS/m), medium organic carbon (4.02 g/kg), low available nitrogen (211 kg/ha), high available phosphorous (112 kg/ha) and medium available potassium (144 kg/ha). The experiment was laid out in randomized block design with nine treatments and replicated thrice with gross plot size of 3.6 x 3.0 m and in completely randomized design. Recommended dose of FYM and nitrogen for Okra is 25 tonnes ha-1 and 125 kg ha-1, respectively. Experiment consisted of nine different manurial treatments. Particulars of nutrients applied in each treatment are specified in Table 1. Entire quantity of manures was applied to each plots 15 days before sowing of the crop and incorporated into the soil. Okra seeds were dibbled at a spacing 60 x 30 cm. Crop received optimum rainfall during entire growing period and lifesaving irrigations was provided at critical stages of the crop. Two inter-cultivation operations and one hand weeding were carried out to suppress the weeds. Neem oil was sprayed to control the pest hazards. Soil samples were collected from each plot before and after the experiment at 0-30 cm depth. The soil samples were dried in shade, sieved (2 mm sieve) and analyzed for pH, organic carbon, available nitrogen, available phosphorus and available potassium content. The pH (soil: water 1:2.5) was measured with the help of pH meter (Jackson, 1973); organic carbon by Walkley and Black chromic acid digestion method as described by Jackson (1973). Available nitrogen in soil was determined by using Kel-plus nitrogen distillation unit (Subbaiah and Asija, 1956). The available phosphorus was determined following the procedure described by Jackson (1973) and potassium was determined flame photometrically by neutral normal ammonium acetate extraction method (Hanway and Heidel, 1952). The pertinent growth, yield, soil nutrient status and soil microbial load parameters were recorded using standard procedures. All the parameters were then analyzed for drawing conclusion using analysis of variance (ANOVA) procedure (Gomez and Gomez 1984).

Treatments	Total quantity of FYM Applied (t ha^{-1})	Total quantity of vermicompost Applied (t ha^{-1})	Total N supplied (kg ha^{-1})
T_1 - Recommended FYM (25 t ha^{-1}) + 100 % N equivalent FYM	25+25	0	250
T_2 - 75 % N equivalent FYM	16.25	0	93.75
T_3 - 100 % N equivalent FYM	25	0	125
T_4 - 125 % N equivalent FYM	31.25	0	156
T_5 - Recommended FYM (25 t ha^{-1}) + 100 % N equivalent vermicompost	25	10	250
T_6 - 75 % N equivalent vermicompost	0	7.5	93.75
T_7 - 100 % N equivalent vermicompost	0	10	125
T_8 - 125 % N equivalent vermicompost	0	12.5	156
T_9 - 50 % N equivalent FYM + 50 % N equivalent vermicompost	12.5	5	125

Table 1: Details of treatments and quantity of manures applied, total quantity of Nitrogen supplied through organic nutrition in each treatment

III. RESULTS AND DISCUSSION

Yield and Yield attributing characters

Yield

Quality and healthy toxic free okra vegetable production remains challenging task in India. Recently, promotion of organic farming over the decade pave a way for organic nutrient and pest management options. Different organic nutrient management practices not only keep soil productive but also increase soil available nutrients for healthy okra yield production. The data on effect of different organic nutrient management practices on yield of okra were presented in (Table 2). Pooled over two seasons data indicated that okra fresh pod fruit yield (t/ha) significantly differed among organic nutrient application treatments. Application of recommended dose of FYM (25 t/ha) along with 100 % N equivalent vermicompost (T5) has recorded significantly highest fruit yield (7.7 t/ha) and was onpar with FYM (25 t/ha) along with 100 % N equivalent FYM (7.3 t/ha). Both T5 and T1 treatments were recorded significantly superior fruit yield (t/ha) over all other treatments. Over the individual years also okra yield follows the same trend due to organic nutrient management practices. Manickam et al (2021) also reported similar yield increment results due to organic nutrient management practices. The yield data were furnished in Table (2).

Tr. No.	Treatments	Fruit yield t ha^{-1}		Pooled data of last 2 years
		2019-20	2020-21	
T_1	FYM + 100 % N equivalent FYM	7.6	7.1	7.3
T_2	75 % N equivalent FYM	4.6	5.0	4.8
T_3	100 % N equivalent FYM	5.2	5.1	5.1
T_4	125 % N equivalent FYM	6.5	6.5	6.5
T_5	FYM + 100 % N equivalent vermicompost	8.0	7.5	7.7
T_6	75 % N equivalent vermicompost	4.8	4.7	4.7
T_7	100 % N equivalent vermicompost	6.1	6.2	6.1
T_8	125 % N equivalent vermicompost	6.7	6.5	6.6
T_9	50 % N equivalent FYM + 50 % N equivalent vermicompost	6.0	5.5	5.7
S. Em.±		0.2	0.2	0.2
C.D. at 5%		0.6	0.6	0.6

Table 2 : Fruit yield of okra as influenced by different organic nutrient management practices

Number of fruit per plant and fruit yield per plant

The number of fruits per plant significantly higher recorded with treatment receiving recommended dose of FYM (25 t/ha) along with 100 % N equivalent vermicompost (10.5 fruits/plant) and was onpar with FYM (25 t/ha) along with 100 % N equivalent FYM (9.3 fruits/plant). Whereas, significantly lower number of fruits per plant recorded by treatment receiving only 75 per cent Nitrogen equivalent FYM. Similar yield parameters increment results with organic nutrient sources were observed by Ullas et al. (2018), Shilpashree et al. (2022), Shanmugan et al (2000), Shanmugan et al (2001), Shwetha and Bablad (2008), Dudhat et al. (1997).The data furnished in Table 3.

Tr. No.	Treatments	Number of fruits per plant	Fruit weight (g)
T_1	FYM + 100 % N equivalent FYM	9.3	11.3
T_2	75 % N equivalent FYM	5.6	7.1
T_3	100 % N equivalent FYM	6.8	8.4
T_4	125 % N equivalent FYM	9.6	9.8
T_5	FYM + 100 % N equivalent vermicompost	10.5	11.8
T_6	75 % N equivalent vermicompost	6.2	7.3
T_7	100 % N equivalent vermicompost	8.5	9.5
T_8	125 % N equivalent vermicompost	8.6	10.0
T_9	50 % N equivalent FYM + 50 % N equivalent vermicompost	7.4	9.1
S.Em.±		0.2	0.3
C.D. at 5%		0.7	1.0

Table 3: Yield parameters of Okra as influenced by different organic nutrient management practices

Growth characters

Plant height

Plant height is an important phenomenon that is greatly influenced by a set of interaction factors involving genetic makeup, nutrition availability and crop environment. In this study the plant height at harvest was significantly higher (75.9 cm) in plots treated with recommended dose of FYM (25 t/ha) along with 100 % N equivalent vermicompost. It was onpar with FYM (25 t/ha) along with 100 % N equivalent FYM (70.9 cm). The significantly lowest plant height was recorded with 75 per cent nitrogen equivalent farmyard application treatment (55.6 cm).

Number of leaves per plant

Number of leaves per plant directly related to chlorophyll formation and as an indicator of plant growth. In the current investigation, significantly higher number of leaves per plant recorded with recommended dose of FYM (25 t/ha) along with 100 % N equivalent vermicompost (37.2) and was onpar with FYM (25 t/ha) along with 100 % N equivalent FYM. The data furnished in Table 4.

Tr. No.	Treatments	Plant height (cm)	Number of leaves at 60 DAT
T_1	FYM + 100 % N equivalent FYM	70.9	34.8
T_2	75 % N equivalent FYM	50.8	24.8
T_3	100 % N equivalent FYM	51.4	25.2
T_4	125 % N equivalent FYM	65.7	32.1
T_5	FYM + 100 % N equivalent vermicompost	75.9	37.2
T_6	75 % N equivalent vermicompost	47.9	23.5
T_7	100 % N equivalent vermicompost	63.3	31.0
T_8	125 % N equivalent vermicompost	66.1	32.3
T_9	50 % N equivalent FYM + 50 % N equivalent vermicompost	55.6	27.3
S.Em.±		2.1	1.0
C.D. at 5%		6.3	3.0

Table 4: Growth parameters of okra as influenced by different organic nutrient management practices

Soil Nutrient Status

The results of the soil samples collected from 0-15 cm depth after the harvest of okra indicates significant variation observed among treatments for available Organic carbon and available nitrogen, phosphorus and potash status. More organic input supplied treatments were found rich in organic carbon and other available nutrients while maintaining optimum pH and electrical conductivity level in the soil.

Among availability of secondary and micro nutrient status in soil, Organic nutrient management practices significantly enhance the availability of sulphur status in the soil.

Tr.	Treatments details	pH (1:2.5)	EC (dSm^{-1})	OC (g/kg)	N (kg/ha)	P_2O_5 (kg/ha)	K_2O (kg/ha)
T1	FYM + 100 % N equivalent FYM	6.9	0.069	8.4	188.2	54.8	258
T2	75 % N equivalent FYM	6.8	0.072	9.2	167.3	52.8	274
T3	100 % N equivalent FYM	7.0	0.077	9.2	188.2	59.7	316
T4	125 % N equivalent FYM	7.2	0.089	9.8	250.9	55.2	355
T5	FYM + 100 % N equivalent vermicompost	6.8	0.081	8.8	209.1	56.8	334
T6	75 % N equivalent vermicompost	7.1	0.094	9.2	146.3	55.6	313
T7	100 % N equivalent vermicompost	6.88	0.077	9.5	230.0	56.2	324
T8	125 % N equivalent vermicompost	6.68	0.079	7.5	209.1	58.75	346
T9	50 % N equivalent FYM + 50 % N equivalent vermicompost	7.08	0.087	7.2	188.2	58.8	337
	Initial	6.0	0.078	7.0	175.0	50.0	238.0
	S.Em.±	0.13	0.007	0.5	38.3	2.6	43.0
	C.D. at 5%	NS	NS	1.6	114.9	7.8	129.2

Table 5a: Nutrient status of soil as influenced by different nutrient management practices in Okra at harvest

Tr. No.	Treatments	Ca	Mg	S	Zn	Fe	Mn	Cu
		Cmol(p+)/kg		mg/kg			mg/kg	
T1	FYM + 100 % N equivalent FYM	2.87	2.70	20.1	0.63	23.01	16.9	0.99
T2	75 % N equivalent FYM	3.12	3.01	14.5	0.61	24.09	15.9	0.96
T3	100 % N equivalent FYM	4.52	2.87	19.0	0.55	24.34	16.1	0.80
T4	125 % N equivalent FYM	3.01	2.35	21.2	0.54	22.16	16.3	1.07
T5	FYM + 100 % N equivalent vermicompost	3.22	3.26	24.2	0.76	24.40	17.2	0.97
T6	75 % N equivalent vermicompost	3.68	2.70	15.7	0.59	23.68	16.2	1.08
T7	100 % N equivalent vermicompost	4.06	3.12	19.0	0.66	23.33	16.8	1.14
T8	125 % N equivalent vermicompost	2.70	3.15	18.3	0.56	23.53	17.9	0.89
T9	50 % N equivalent FYM + 50 % N equivalent vermicompost	3.22	3.71	18.3	0.50	21.3	17.5	1.07
	Initial	3.1	2.56	12.3	0.57	21.8	15.6	0.78
	S.Em±	0.61	0.49	1.66	0.06	1.22	0.46	0.11
	C.D. at 5%	NS	NS	4.10	NS	NS	NS	NS

Table 5b : Secondary and micronutrients as affected by organic nutrients management practices in Okra

Soil Microbial Populations

Beneficial soil microbes are an indicator of healthy and productive fertile soils. In this current investigation treatments supplied more organic nutrients found rich in beneficial bacterial, fungal, actinomycetes and nitrogen fixers soil beneficial microorganisms.

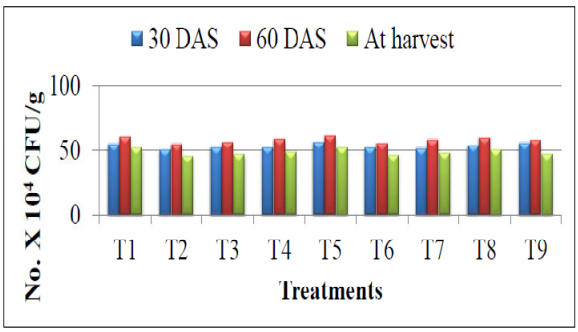


Fig 1: Bacterial population (cfu g-1 of soil) of Okra crop soil as influenced by different organic nutrient management practices.

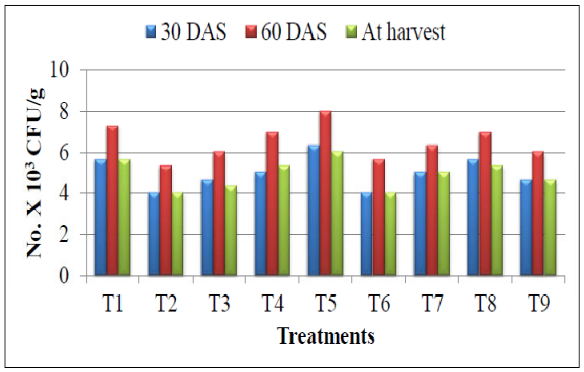


Fig2: Fungal population (cfu g-1 of soil) of Okra crop soil as influenced by different organic nutrient management practices.

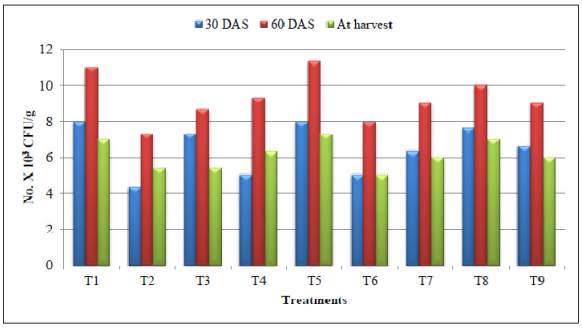


Fig 3: Actinomycetes population (cfu g-1 of soil) of Okra crop soil as influenced by different organic nutrient management practices

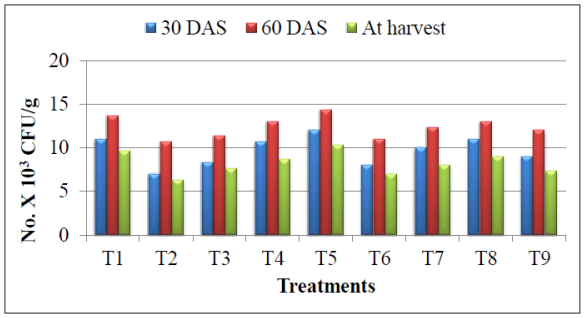


Fig 4: Nitrogen fixers population (cfu g-1 of soil) of Okra crop soil as influenced by different organic nutrient management practices.

Economics

Cost of cultivation

The organic nutrient management practices showed large variation in the cost of cultivation due to the use of different inputs. The per hectare cost of cutivation was the highest (Rs. 97,200/ha) in plots treated with FYM+ 100 per cent Nitrogen equivalent FYM. This was due to the higher cost incurred towards farmyard manure when compared to other treatments. The lowest cost of cultivation is recorded with only 75 per

cent Nitrogen equivalent vermicompost application (Rs. 62,200/ha) Table 6.

Gross return

Among the organic nutrient management practices treatment applied with recommended dose of FYM (25 t/ha) along with 100 % N equivalent vermicompost recorded highest gross return of Rs. 1,90,093/ha and was onpar with FYM (25 t/ha) along with 100 % N equivalent FYM.

Net Return:

Among the organic nutrient management practices treatment applied with recommended dose of FYM (25 t/ha) along with 100 % N equivalent vermicompost recorded highest net return of Rs. 1,07,726/ha the treatment was followed by FYM (25 t/ha) along with 100 % N equivalent FYM (Rs.92,893/ha).

Tr. No.	Treatments	Cost of cultivation (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	BC ratio
T_1	FYM + 100 % N equivalent FYM	97200	190093	92893	1.96
T_2	75 % N equivalent FYM	65950	114967	49017	1.74
T_3	100 % N equivalent FYM	72200	129986	57786	1.80
T_4	125 % N equivalent FYM	78450	164383	85933	2.10
T_5	FYM + 100 % N equivalent vermicompost	92200	199926	107726	2.17
T_6	75 % N equivalent vermicompost	62200	121942	59742	1.96
T_7	100 % N equivalent vermicompost	67200	154146	86946	2.29
T_8	125 % N equivalent vermicompost	72200	169240	97040	2.34
T_9	50 % N equivalent FYM + 50 % N equivalent vermicompost	69700	149884	80184	2.15

Table 6 : Economics of organic nutrients management practices in Brinjal

IV. CONCLUSION

From the above experiment it can be concluded that, For achieving higher Okra/Bhendi yield among organic nutrient management practices, it was proposed that following application of recommended dose of FYM (25 t/ha) along with 100 % N equivalent vermicompost or FYM (25 t/ha) along with 100 % N equivalent FYM will be beneficial to farmers for getting highest fresh pod fruit yield and net returns under organic production system.

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